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Food security change in the college student population due to the COVID-19 pandemic: A decline for many, an improvement for a few

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ABSTRACT

The COVID-19 pandemic killed over one million people in the United States and the disease itself, combined with policies implemented to minimize its spread, dramatically increased both unemployment and food insecurity throughout the nation. College students, who have high rates of food insecurity during non-pandemic times, were heavily impacted by the pandemic as campus closures caused large changes in living conditions and business closures led to loss of work for many. This study quantified changes in the food insecurity rate, changes in food security status, and associates of these changes for college students at the University of Santa Barbara, CA using data from a survey conducted in the Spring of 2021 (N = 785). Descriptive statistics and a multinomial logistic regression model were used to analyze data and the results suggest that the food insecurity rate increased by about 50% during the pandemic and that food security status changed for about 25% of students. Of students whose statuses changed, one-fifth experienced an improvement in food security status while about four-fifths experienced a decline. Students who lost a job were more likely to experience a decline in food security status while students who moved in with their parents, especially for longer periods of time, were more likely to experience an increase in food security status. During future pandemics, policy should account for a large increase in college student food insecurity and future research should determine which students move home and why.

1. Introduction

In early December of 2019, a cluster of patients in Wuhan, China contracted a pneumonia-like illness that did not respond well to treatment and at the end of the month, the World Health Organization (WHO) was notified. The virus was sequenced on January 10th of 2020 and on January 20th, the United States Center for Disease Control reported the first confirmed case of COVID-19 within the United States (CDC, 2023). Over the next two months, governments and health agencies throughout the World worked to track the virus and develop appropriate responses, and on March 11th, WHO officially declared a pandemic (CDC, 2023).

Over the next year, governments, public health agencies, and colleges and universities mandated social-distancing requirements and business closures, which combined with the detrimental health effects of the virus itself, had severe impacts on the United States financial (Belitski et al., 2022), political (Schraff, 2021), health care, and educational systems (Kaye et al., 2021). In the US alone, COVID-19 caused over 6.2 million hospitalizations and led to over 1.1 million

deaths (Johns Hopkins, 2023). The unemployment rate more than tripled (from 4% to 14.7%) in the first several months of mandated business closures and though it declined thereafter, it remained above pre-pandemic levels for many months. Furthermore, unemployment rates were greatest among already economically marginalized groups including teenagers, low-income households, and ethnic/racial minorities (US Bureau of Labor Statistics, 2022) and with the reduced incomes this caused, many households in the general population experienced declines in food security.

Food security is defined as the ability to acquire sufficient or appropriate food in a socially acceptable manner to have an active and healthy life (FAO, 2006). In the five years prior to the pandemic, the food insecurity rate in the US population was around 11% (Coleman-Jensen, 2019). This rate increased to 34% during the pandemic (Fitzpatrick et al., 2021), a level that had not existed in the US in decades, including during the great recession (2008–2009) (Wolfson & Leung, 2020a). Furthermore, tracking with the impacts to unemployment outlined above, previously economically marginalized groups were the most likely to experience food insecurity. For example, rates of

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food insecurity for low-income households (45%), black households (48%), Hispanic households (52%), and households with children (54%) were all much higher than the average rate of 34% (Wolfson & Leung, 2020b).

College students were likely to be highly impacted by the pandemic as policy changes dramatically altered their work, living and educational systems. In California (USA), a state of emergency was declared on March 4th, 2020, and a shelter-in-place order was issued on March 19th, 2020 (Procter, 2021). On March 11th the University of California (UC) declared that all instruction and testing would be remote for the remaining two weeks of Winter quarter and on March 14th, the university announced that all in-person instruction would be canceled for the Spring quarter as well. Students were encouraged to leave campus housing if they could safely do so, and to take all of their personal belongings with them. During the summer, UCSB determined that all instruction for the upcoming academic year (2020–2021) would be remote and that very few students would be allowed to live in campus housing. These policies persisted throughout the academic year of 2020–21.

College students were likely to experience food security changes during the pandemic as they have high rates of food insecurity during normal times and pandemic policies dramatically altered their lives. Given that 45 percent of full-time, traditional-age students work (Perna, 2010) and that 40 percent of full-time college students at public universities and 64 percent at private universities live on-campus, business and campus housing closures were likely to have large impacts on student well-being. Furthermore, many students exist in precarious financial situations during normal times. In a national study conducted at both two- and four-year universities, Broton and Goldrick-Rab (2018) estimated that 45% of students experienced food insecurity. Similar results were found in a recent review paper which analyzed college student food insecurity rates from 17 peer-reviewed articles and 41 pieces of gray literature. The average food insecurity rate was 42% in the former and 35% in the latter (Bruening, K, D, & Mn, 2017). Last, in biannual surveys conducted at the University of California (UC), the largest public university system in the world with over 280,000 students, calculated food insecurity rates vary between campuses, but average around 45% (UCUES, 2023).

In addition to the high rates of food insecurity in the college student population, rates vary widely between students with different demographics and characteristics. For example, in a study conducted at University of Missouri, Kansas City (UMKC), LGBTQ students were found to have 74% greater odds of being food insecure than their non-LGBTQ peers. Similar results were found at the UC, where LGBTQ students were determined to have 34% greater odds of being food insecure than their non-LGBTQ counterparts (University of California, 2017). Food insecurity also varies between students of different races/ethnicities. In the UMKC study, Hispanic students were found to have 66% greater odds of experiencing food insecurity than that of white students (Willis, D.E., 2019) and Maroto et al. (2015), conducting research at two community colleges in Maryland, found that the prevalence of food insecurity was almost twice as high for Black students than for White students. Similar results have been documented within the UC system where African-American, Hispanic, and Asian students were found to be at 230%, 64% and 15% greater odds of being food insecure than were white students, respectively (University of California, 2017).

As within the general population (i.e., Gundersen & Ziliak, 2015), research on the college student population has linked food insecurity to multiple negative outcomes (Bruening, K, D, & Mn, 2017). Food insecurity tends to associate with lower quality diets and less healthy eating habits (Bruening et al., 2016; Bruening, K, D, & Mn, 2017) and food-insecure students report higher levels of stress, depression, and anxiety (Bruening et al., 2016; Bruening et al., 2017; Payne-Sturges, Tjaden, Caldeira, Vincent, & Arria, 2018). Furthermore, food insecure students are three times more likely than food secure students to not

attend class and are four times as likely to report problems with their abilities to focus and engage with material once there (Silva et al., 2017).

The overarching purpose of this paper is to determine if and how student food insecurity at UCSB changed during the COVID-19 pandemic of 2020. More specific research questions are as follows: 1. If and how did the COVID-19 pandemic of 2020–2021 cause the overall food insecurity rate to change, 2. For what percentage of students did food security status stay the same, improve, or decline during the pandemic and 3. What mechanisms caused changes in food insecurity rate and food security status?

2. Materials and methods

2.1. Survey

Data for this study were collected with an online survey conducted with a random sample of undergraduate students at UCSB in May of 2021. The survey asked questions about food insecurity, housing, and living conditions, in the 12 months before and the 12 months during the pandemic (see Fig. 1), as well as many questions about student characteristics and demographics. The initial invitation to participate was sent on May 1st, 2021, and three reminder emails were sent over the next three weeks, giving students four weeks in total to respond. The survey was distributed to a randomly selected 4800 undergraduates (~20% of the student population) using the Qualtrics survey platform, and 785 students responded to the survey, yielding a response rate of 16%. The survey took respondents 15 min to complete, on average and participation was incentivized with one-hundred, \$50 dollar gift cards which were given out via random drawing. The study was approved by UCSB's Human Subjects Institutional Review Board.

2.2. Metrics and measures

Food security was assessed using the six-item, United States Department of Agriculture (USDA) Food Security Survey Module (FSSM) (Table 1) (USDA, 2012). Respondents were asked to complete the FSSM for both the 12-month period prior to the start of the pandemic and the first 12 months of the pandemic. Food insecurity levels were determined following the standard procedure. The number of affirmative responses to the six FSSM questions were summed and students with 0–1 affirmative responses were labeled 'food secure', those with 2–4 affirmative responses were labeled 'low food security' and those with 5–6 affirmative responses were labeled as having 'very low food security'. Additionally, for some components of the analysis the 'low food security' and 'very low food security' categories were compressed into the single category, 'food insecure', to improve both ease and interpretation of analysis.

To determine food security status change for each respondent, food security status pre-pandemic was compared to their status during the pandemic. If it was the same, the respondent was labeled as 'no change'. If food security status was lower during the pandemic, the student was labeled as 'less food secure during the pandemic' and if food security status was higher during the pandemic, the student was labeled as 'more food secure during the pandemic'. The latter was composed of students whose food security statuses went from very low to low, low to secure, or very low to secure while the former was composed of students who had status changes from secure to low, low to very low, and secure to very low.

2.3. Statistical analysis

Data analysis included descriptive statistics, chi-squared analysis, and multinomial logistic regression. Descriptive statistics were calculated for all dependent and independent variables and chi-squared tests of independence were used to determine if change in food security status

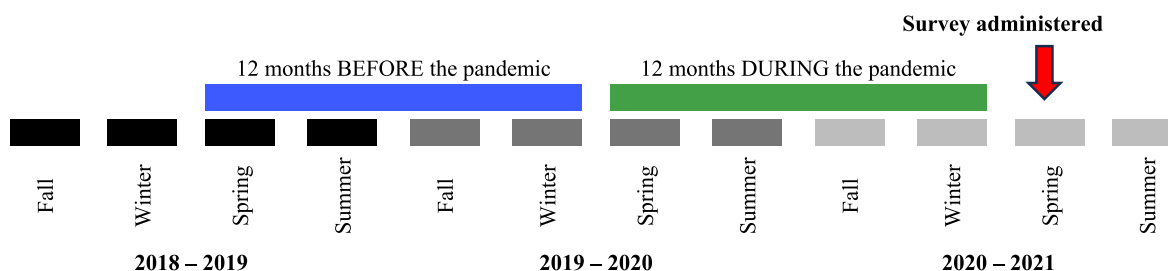


Fig. 1. Timeline of survey administration and the two time periods for which food security was assessed across academic years and quarters.

Table 1
USDA fFood sSecurity Survey Module (FSSM): Six-item Short Form.

Please tell me whether the following statements were often true, sometimes true, or never true for you in the indicated 12-month period.

- The food that I bought just didn't last, and I didn't have money to get more.
- I couldn't afford to eat balanced meals.

For each of the following statements, please indicate whether or not you experienced that condition in the indicated 12-month period (yes/no).

- Did you ever cut the size of your meals or skip meals because there wasn't enough money for food?
- If so, how often did this happen? (almost every month, some months but not every month, in only one or two months)
- Did you ever eat less than you felt you should because there wasn't enough money for food?
- Were you ever hungry but didn't eat because there wasn't enough money for food?

was associated with individual independent variables for the univariate case (Tables 2–5). The univariate cases were included because they are easily interpretable and allow practitioners to have a fuller understanding of which students are experiencing hardship. Last, a multinomial logistic regression model was included to determine the associates of change in food security status while conditioning on common demographic variables, such as socioeconomic status (Table 5). Multinomial logistic regression was used because the dependent variable ‘food security status change’ is categorical and with more than two discrete outcomes (Kwak & Clayton-Matthews, 2002). All analyses were conducted in R studio, version 4.2.2.

3. Results

3.1. Changes in food insecurity rate and food security status

There was an almost 50% increase in food insecurity in the sampled student population with 31% experiencing food insecurity prior to the pandemic and 46% experiencing food insecurity during the pandemic. Furthermore, most of this increase in food insecurity was accounted for by the increase in very low food security, which went from 13% to 23% of individuals, an almost 72.1% increase in occurrence (Table 2). Furthermore, when students were asked if their food insecurity was caused by the pandemic, 78.9% stated affirmatively. Tracking individual students, about one-quarter had a change in food security status across the two time periods and of those, 80% had a lower status while

Table 2
Number and percent of students experiencing each food security level before and during the pandemic.

Levels	Before		During	
	Percent	Number	Percent	Number
Food Secure	68.92	541	53.5	420
Food Insecure	31.08	244	46.5	365
Low food security	17.83	140	23.69	186
Very low food security	13.25	104	22.81	179

Table 3
Percent of students experiencing each type of food security status change (N = 785).

Food security status	Percent
Did not change	76.7
Secure	50.1
Insecure	26.62
Changed	24.3
Secure to insecure	19.87
Insecure to secure	4.46

20% had a higher status during the pandemic (Table 3).

3.2. Variation across independent variables

Food insecurity varied widely across many of the independent variables included in the analysis with housing and changes in work playing out-sized roles. Approximately 60% of students moved back in with their parents for at least some amount of time and of those, about 50% moved home for three to four quarters, while only 10% moved home for less than a quarter. In contrast, 24% of all respondents lived with their parents for the entire course of this study (these were primarily high school seniors before the pandemic who stayed home for their freshman year of college) while 15.5% of students did not move back home at all (Table 4).

Students who moved home with their parents for four quarters had the lowest food insecurity rate during the pandemic (34.7%) and were the most likely to have a positive change in food security status (23.1%) when compared to students with other living situations. Students who moved back in with their parents for three quarters had the second lowest food insecurity rate during the pandemic, and for many in this group, food security improved as well. Students who spent less than three quarters living back at home, whether it be for two quarters, one quarter, or less than a quarter, had similar food insecurity rates to one another (around 53%), and rates that were distinctly higher than that of students who moved home for longer periods of time. Similarly, these students were less likely to have better food security during the pandemic (around 7.5%) and much more likely to have a negative change in status (around 39%). For students who did not move back in with their parents at all, their food insecurity rate and food security status changes were similar to that observed for students who moved back home for less than three quarters. Finally, students who lived with their parents both before and during the pandemic had the largest increase in observed food insecurity (128%). These students were also the least likely to have an improvement in food security status during the pandemic. However, these students still had the second lowest food insecurity rate based on living condition and the large change in status was attributable to the very low food insecurity rate of these students prior to the pandemic (17.5%) (Table 4).

Several variables that associate with socioeconomic status (SES) were found to associate with food insecurity and status change. Students who were food insecure before the pandemic were more likely to be food

Table 4

Food insecurity rates before and during the pandemic for each variable, results of individual logistic regression models between each variable and the dependent variable food insecurity (0/1) and food security status change across all variables.

Variables (Levels)	# (%)	Food insecurity rate			Food security status change		
		Before (%)	During (%)	LRs p-Values	Positive	No change	Negative
Food insecure before				< 0.001***			
No	541 (68.9)		28.82		1.1	60.1	38.8
Yes	244 (31.0)		85.65		29.9	34.4	35.7
Housing insecure							
No	539 (71.9)	23.9	37.8		9.1	57.1	33.8
Yes	210 (28.0)	47.6	68.6		11	39.5	49.5
Where lived (Reference: Four quarters)							
Four quarters	147 (19.3)	40.1	34.7	ref.	23.1	47.6	29.3
Three quarters	68 (8.9)	35.3	45.6	0.127	14.7	41.2	44.1
Two quarters	115 (15.1)	29.6	53	0.003**	5.2	49.6	45.2
One quarter	85 (11.1)	34.1	54.1	0.004**	10.6	51.8	37.6
< One quarter	46 (6.0)	28.3	52.2	0.035*	4.3	56.5	39.1
Never with parents	118 (15.5)	36.4	55.1	<0.001***	8.5	54.2	37.3
Parents entire time	183 (24.0)	17.5	39.9	0.333	2.2	60.7	37.2
Working at start of pandemic				< 0.001***			
No	447 (57.7)	26.4	39.4		10.5	54.8	34.7
Yes	328 (42.3)	37.5	56.1		9.8	48.2	42.1
Transsexual				0.216			
No	732 (97.6)	30.1	46.2		8.9	53	38.1
Yes	18 (2.4)	66.7	61.1		44.4	16.7	38.9
Sex at birth				0.741			
Female	505 (67.9)	29.3	45.3		8.3	53.5	38.2
Male	238 (32.0)	32.8	46.6		12.2	51.3	36.6
Sexuality				0.071 [†]			
Heterosexual	568 (73.9)	28.2	44.4		8.1	54.2	37.7
Not heterosexual	201 (26.1)	38.8	51.7		15.4	45.8	38.8
Participant in Education Opportunity Program				< 0.001***			
No	525 (66.8)	23.4	39.4		7.4	57.1	35.4
Yes	260 (33.1)	46.5	60.8		15.4	41.9	42.7
Race/ ethnicity							
East Asian	169 (22.2)	17.8	30.2	ref.	9.5	60.9	29.6
Pacific Islander	8 (1.1)	37.5	62.5	0.072	12.5	50	37.5
White	240 (31.5)	25	42.5	0.0115*	7.1	56.7	36.2
East Indian	34 (4.5)	41.2	50	0.028*	17.6	50	32.4
Southeast Asian	86 (11.3)	32.6	55.8	<0.001	4.7	40.7	54.7
African-American	27 (3.5)	55.6	74.1	<0.001	11.1	37	51.9
Hispanic	197 (25.9)	44.7	58.4	<0.001	15.7	42.1	42.1
International student	0.694						
No	706 (90.28)	31.2	46.3		10.2	52.5	37.3
Yes	76 (9.7)	30.3	48.7		9.2	46.1	44.7
Domestic out-of- state	0.747						
No	696 (89.6)	31	46.3		10.5	52	37.5
Yes	81 (10.4)	32.1	48.1		7.4	50.6	42
Admission status				0.003**			
Freshman	640 (81.9)	28	44.1		9.4	52.7	38
Transfer	141 (18.1)	45.4	58.2		13.5	48.2	38.3

(continued on next page)

Table 4 (continued)

Variables (Levels)	# (%)	Food insecurity rate			Food security status change		
		Before (%)	During (%)	LRs p-Values	Positive	No change	Negative
Academic level							
Freshman	150 (19.2)	35.3	52	0.024*	11.3	48.7	40
Sophomore	241 (30.9)	39.8	50.2	0.030*	12.4	48.1	39.4
Junior	191 (24.5)	30.9	44.5	0.348	12.6	50.3	37.2
Senior	196 (25.1)	17.3	39.8	ref.	4.1	60.2	35.7

Significance codes: *** = < 0.001, ** = 0.001 to 0.01, * = 0.05, ' ' = 0.1. In the p-value column, the reference level for variables with more than two levels is labeled as 'ref.'

insecure during the pandemic (85.7% vs. 28.8%) and the 42.3% of students that were working when the pandemic started were more likely to be food insecure as well (56.1% vs. 39.4%). Participation in the Educational Opportunity Program (EOP) (UCSB, 2024) was associated with an almost 50% greater chance of food insecurity, and this is not surprising as only low-income students are admitted into the program. Despite the greater food insecurity rate, EOP students had a smaller change in food insecurity rate and were much more likely to have food security status increase during the pandemic (Table 4).

Relative to the above, there was less variation in food insecurity rate across the variables biological sex, sexuality, and gender identity. While transsexual students had a much higher food insecurity rate (61% versus 46%) than non-transsexual students during the pandemic, this was not a statistically significant difference in the univariate model. The differences in food insecurity across biological sexes and based on sexuality were less than a few percent. Despite this, transsexual students were much more likely than their counterparts to experience a positive change in food security status during the pandemic. Similarly, while non-heterosexual students only had a slightly higher food insecurity rate than heterosexual students (52% vs 44%), the former were more likely to have an improvement in food security status during the pandemic (Table 4).

There were wide variations in food insecurity rate and status change across race/ethnicity. African-Americans, Pacific-Islanders, and Hispanics had the highest rates of food insecurity of all race/ethnicity groups at 74%, 63%, and 58%, respectively. On the other hand, Asian-America, White, and East-Indian students had the lowest food insecurity rates at 32%, 42%, and 50%, respectively. There was also much variation in food security status change across race/ethnic groups with the Southeast Asian group having the smallest percentage of students with better food security during the pandemic (4.7%) and the East Indian group having the largest (17.6%) (Table 4).

Last, food insecurity rate and status change did not vary much across academic level, with the exception of senior-level students, who had a greater increase in food insecurity rate (17.3%–39.8%) and were less likely to have an improvement in food security status (4.1%). The food insecurity rate was about 30% higher for transfer students during the pandemic but change in status was similar between them and freshmen admits. Neither country of residence nor US state of residence seemed to associate with food insecurity rate or food security status change (Table 4).

3.3. Multinomial logistic regression

The multinomial logistic regression model was estimated with all independent variables of interest to determine if and how housing changes altered food insecurity status after conditioning for known associates, such as socioeconomic status (SES). Socioeconomic status, at least in how it was measured in this study, did associate with food security status change. EOP participants had 0.795 greater log odds than non-EOP students of having a better food security status rather than the same food security status during the pandemic (Table 5). Furthermore, students who were working when the pandemic began had 0.424 greater log odds than students who were not working of being less food secure

during the pandemic versus having their food security status stay the same.

Housing variables were also significant associates of food security status change once SES was accounted for. Students who moved home for two quarters (or less) had smaller log odds than students who moved home for four quarters of being more food secure during the pandemic rather than having food security stay the same. For example, students who moved home for two quarters had 1.209 smaller log odds of having a positive food security status change rather than no status change relative to that of students who moved home for the entire pandemic. While students who moved home for three quarters did not have smaller log odds of being more food secure than students who moved home for four quarters, they did have greater log odds of being less food secure during the pandemic. Last, students who reported that they were housing insecure during the pandemic had 0.623 greater log odds than their housing secure counterparts of being less food secure rather than having the same status during the pandemic (Table 5).

Race/ethnicity was a significant associate of food security status change in the regression model as well. White students, southeast Asian students, and African-American students all had greater log odds than East Asian students of having a decline in food security status rather than no change in status during the pandemic. Pacific Islanders had 11.745 lower log odds of having an improvement in food security status rather than no change in status relative to the reference group (Table 5).

In terms of sexuality and gender identity, the difference between transsexuals and non-transsexuals observed in the univariate case was not significant in the regression model. However, students identifying as not heterosexual, had 0.930 greater log odds of having an improvement in food security status rather than the same food security status, relative to their heterosexual counterparts.

Student's residence status also showed effects of food security status change. International students had 0.053 greater log odds of having a decline in food security status ($p = 0.053$) and out-of-state students had 1.559 lower log odds of having an improvement in food security status relative to that of CA residents (Table 5).

4. Discussion

4.1. Study results

This study examined if and how the COVID-19 pandemic impacted undergraduate student food security at the University of California, Santa Barbara in the first twelve months of the campus shut-down (Spring Quarter, 2020 to Spring Quarter, 2021) and results suggest that the pandemic caused the food insecurity rate to increase. While 31.1% of students experienced food insecurity prior to the pandemic, 46.5% did so during the pandemic, an approximate 50% increase in food insecurity rate. Furthermore, this study found that food security status changed for 25% of students during the pandemic and that of the students experiencing this change, about four-fifths experienced a decline in status and one-fifth experienced an improvement in status. The major drivers of the observed changes in food security were changes to housing and loss of employment. The campus housing closures created massive disruptions for students, with 28% of students in this survey

Table 5
Multinomial Logistic Regression results with the dependent variable ‘food security status change’ (reference: no change in food security status).

Variables (Levels)	More food secure during the pandemic		Less food secure during the pandemic	
	Log odds	p-Value	Log odds	p-Value
Intercept	-2.005	0	-1.556	0
Housing insecure (Reference: No)				
Yes	0.173	0.634	0.623	<0.001***
Moved back in with parents (Reference: Four quarters)				
Three quarters	0.189	0.687	0.609	0.09 [†]
Two quarters	-1.209	0.027*	0.378	0.212
One quarter	-0.581	0.274	0.137	0.692
Less than one quarter	-1.988	0.063 [†]	0.237	0.55
Parents entire time	-2.365	<0.001***	0.039	0.887
Never lived with parents	-1.238	0.021*	-0.214	0.511
Working at start of pandemic (Reference: No)				
Yes	0.134	0.684	0.424	0.019*
Transsexual (Reference: No)				
Yes	0.924	0.438	-0.103	0.923
Sex at birth (Reference: Female)				
Male	0.404	0.225	0.113	0.555
Sexuality (Reference: Heterosexual)				
Not heterosexual	0.93	0.008**	0.246	0.239
Participant in Education Opportunity Program (Reference: No)				
Yes	0.795	0.033*	0.176	0.411
Race/ ethnicity (Reference: East Asian)				
Pacific Islander	-11.745	<0.001***	0.838	0.305
White	-0.034	0.946	0.489	0.065 [†]
East Indian	0.695	0.299	0.554	0.232
Southeast Asian	-0.736	0.307	1.022	<0.001***
African-American	-0.073	0.937	1.364	0.007**
Hispanic	0.44	0.347	0.67	0.018
International student (Reference: Domestic)				
Yes	1.121	0.108	0.731	0.053 [†]
Domestic out-of- state (Reference: No)				
Yes	-1.559	0.086 [†]	-0.111	0.745
Admission status (Reference: Freshman admittance)				
Transfer	0.466	0.231	0.172	0.458

Significance codes: *** = < 0.001, ** = 0.001 to 0.01, * = 0.05, ‘†’ = 0.1. In the p-value column, the reference level for variables with more than two levels is labeled as ‘ref.’.

experiencing housing insecurity, a rate much higher than what’s normally observed in the college student population (<5%) (UCUES, 2023). Furthermore, housing insecure students were much more likely to experience food insecurity (68.6% vs 37.8%) and to have a negative change in food security status during the pandemic (49.5% vs 39.5%) relative to their housing secure counterparts. The housing closure also caused many students (60.5%) to move back in with their families, at least for a short amount of time, and these students had better food

security outcomes than their counterparts. For example, of students who moved back home for four quarters, 23.1% were more food secure during the pandemic than they were before the pandemic, while of students who moved home for less than one quarter, just 4.3% experienced positive change. Moving home in no way guaranteed an improvement in food security status, however. For example, of students who moved home for four quarters, 29.3% experienced a decrease in food security during the pandemic. Last, changes in work conditions strongly impacted food security and this is important as 42.3% of surveyed students were working before the pandemic began. Working students had both a greater food insecurity rate during the pandemic (56.1% vs 39.4%) and were more likely to experience a negative food security status change during the pandemic (42.1% versus 34.7%) relative to their non-working counterparts.

While the connection between loss of employment and food insecurity is straight forward (loss of income = less money for food), the relationship between housing changes and food security is less transparent. It is likely that moving back in with their parents may have improved student food security through the collectivization of resources. Students who moved home may have saved thousands of dollars in rent over the course of the year, freeing up money to spend on food. Similarly, a greater percentage of their food may have been purchased for students by their parents while they were living at home. Furthermore, living at home may have improved student’s access to grocery stores as many students living on or near campus don’t have motor vehicles, making it difficult to easily, and cheaply buy groceries. Another valuable resource that is often lacking in college living situations, namely kitchen and refrigerator space, may have increased for students moving home as many students living in Isla Vista share houses with eight or nine people. If this allowed students to cook food at home rather than purchasing already prepared food, food security may have improved as the latter is a more costly option. Last, moving back in with parents may have led to improved food security if students who struggled with food insecurity due to lack of food prep knowledge or lack of (or poor) budgeting found themselves in more knowledge rich environments or in environments where these decisions/behaviors were collectivized or managed by others.

4.2. Past studies

Other research published on this subject generally agrees with the results of this paper though there is some variation in food insecurity rates, food security status change, and the mechanisms driving these changes across different studies. In regard to food insecurity rate change, research conducted at a large public university in the south-eastern United States found that food insecurity increased by 34.3% during the pandemic (from 10.8% to 14.5%) (Soldavini et al., 2021), a change in rate closest to that observed in this study. Similarly, a study conducted across 19 colleges and universities in the US found an increase in food insecurity of 36.5%, though this number was calculated based on responses to the single question, “I was worried whether my food would run out before I got money to buy more”. In the same study, there was just a 20.5% increase in affirmative responses to the statement, “The food I bought just didn’t last and I didn’t have money to get more” from the time-before to the time-during the pandemic (Vilme et al., 2022). Much smaller increases in food insecurity rates were found in other studies. Food insecurity was found to increase just 16% in a study conducted at a large, Midwestern, public university (from 25% to 29%) and Kim and Murphy (2022) found an increase in food insecurity of just 3.11% (from 34.4% to 35.5%) at a major public university in Virginia. Last, in a study which surveyed students at three public universities in New York state, food insecurity rate was found to not change significantly during the pandemic (22.73%–24.81%) (<link id=bib_ahmed_et_al_2023>Ahmed, Ilieva, et al., 2023; </link>).

The literature also shows varying levels of food security status change from the time before to the time during the pandemic. Whereas

in this study, 24% of respondents had a food security status change (19% decline and 5% an improvement), Soldavini et al. (2021) determined that 32% of students had a change with 20% exhibiting a decline and 12% exhibiting an improvement. Similarly, Mialki et al. (2021) found that 37.2% of students had a status change, with 22.6% experiencing a decrease and 15% experiencing an improvement. Other studies looked at change in food security status but in less detail. Research conducted at West Virginia University, showed that 15% of students had a decrease in status during the pandemic, but they did not show results for students whose food security status improved (Hagedorn et al., 2022). Similarly, while Kim and Murphy (2022) found that 18% of students had a change in food security status during the pandemic, they did not determine (or at least present in their paper) the proportion of the 18% that had a positive versus negative change.

In regard to the mechanisms driving food security change during the pandemic, other studies have found similar results to those found here; namely that housing changes and loss of work were primary drivers. For example, Mialki et al. (2021) found that for students who moved back home during the pandemic, 19.2% were more food secure and 18.3% were less food secure while of students who did not move home, 11.2% were more food secure and 27.6% were less secure. Similarly, Soldavini et al. (2021) found that of students who moved back home, 17.4% had better food security while 16.8% had worse food security, and that of students who did not move back home, just 5.3% had better food security, and 23.8% had worse food security.

4.3. Reasons for variation across studies

The variation in food insecurity rate change and food security status change across studies may be due to both real world effects and methodological differences between studies. For the former, food insecurity rates vary greatly from campus-to-campus during non-pandemic times, making it likely that food insecurity would vary greatly between campuses during the pandemic as well, with some of this variation explained by campus type. For example, two-year colleges generally have food insecurity rates almost twice as high as four-year colleges (Brotton & Goldrick-Rab, 2018) and a variety of college types were used in the studies cited in this paper. Though there are a variety of explanations for these between campus differences, differing costs of attendance may be a determining factor. Tuition varies widely between the different types of colleges. Within the State of California higher education system alone, many junior colleges provide free tuition to county residents, while the UCs cost (tuition and fees) over \$16,000 per year and the CSUs cost around \$8000 per year (CSU Tuition, 2023; UC Tuition, 2023; CCCC Tuition, 2023). Furthermore, even between colleges of the same type, food insecurity rates may vary widely due to different economic factors such as housing prices. For example, the higher rate of food insecurity assessed in this study may be due to Santa Barbara having some of the highest rent prices in the nation leading to the students being in a nearly constant state of housing crisis (Independent, Liu, 2021). Additionally, there are numerous social and demographic variables that operate at the level of the individual student, such as parent income and parent educational attainment, that vary widely across college campuses and associate strongly with student food security. These are likely to have contributed to the differences in food security rates and food security status changes observed within this body of literature. Last and though a detailed discussion is outside the scope of this study, states, colleges and universities implemented different pandemic policies and/or similar policies at different times, and this variation may have contributed to the wide variation in observed pandemic-caused food security changes across different articles.

In addition to these real-world drivers of differences, there are a multitude of methodological differences between studies that may explain some of the variation in food security rate changes and food security status changes. First, several different food insecurity assessment tools were used across studies. For example, this study used the

USDA 6-item Food Security Survey Module (FSSM), while 5 of the studies used the USDA 10-item Adult Food Security Survey Module (AFSSM) (<link id=bib_ahmed_et_al_2023b>Ahmed, Shane, et al., 2023; </link>; Glantsman et al., 2022; Kim & Murphy, 2022; Mialki et al., 2021; Soldavini et al., 2021). Additionally, two of the cited studies used the two-item validated Hunger Vital Sign (HVS) screening tool (Hagedorn et al., 2022; Vilme et al., 2022). Additionally, the way food security status change was calculated differed between studies. For example, Mialki et al., calculated status change using raw numeric scores (0–6) while this study assessed change using categorical food security status (food secure, low, very low). The former method tends to yield higher changes in status percentages than the latter. For example, using raw numeric scores to calculate food security status change in this study almost doubles the estimate; from 24% to 47%. These studies also used different time frames in which to assess food security. For example, Hagedorn et al., (2022) conducted their study in March of 2020 and Kim and Murphy (2023) ran their survey from April to July of 2020, yielding shorter time frames of assessment than used here. This study was conducted in March and April of 2021, giving a 12-month time frame in which to capture the student experience, potentially leading to the high rate of pre-pandemic to during-pandemic increase in food insecurity observed in this study.

4.4. Limitations/future research

There were several limitations to this study. First, this study used the FSSM to assess food insecurity and there have been questions raised in the literature about the validity of the FSSM for use in the college student population (Nikolaus et al., 2019a, 2019b). Furthermore, the 6-item FSSM is also a rather coarse tool. It places all respondents into one of three categories (food secure, low food security, and very low food security), which may hide much of the variation in the population. Additionally, for a situation as dynamic as the COVID-19 pandemic, utilizing the instrument for a twelve-month period eliminates understanding of effects that occurred at finer temporal resolutions. In addition to problems associated with the use of the FSSM, this study also relied on recall data. While the time period utilized by the FSSM is typically the 12-month period prior to the survey, this study also asked about the 12-month period prior to this, thereby expanding the window of recall. Recall data can lead to diminished accuracy generally (Clarke et al., 2008), and asking respondents about experiences from two years prior to the study may be problematic. Last, because this study was only conducted at one campus within the University of California system, the results are not necessarily generalizable to other colleges and universities.

Despite these issues, the FSSM is commonly used in the student population as no other food security measurement tools have been validated for use in the college student population. While it may not be extremely accurate at determining absolute levels of need, it is adequate for comparing between groups. Furthermore, while recall data can be problematic, the two time periods used in this study were clearly delineated as they coincided with the campus shutdown and the start/end of academic quarters; potentially improving recollection and limiting recall bias.

Future research on this topic should determine why certain students stayed near campus while others moved home as this was an important moderator of pandemic-induced food security change. Furthermore, now that several years have passed since the start of the pandemic, a thorough review of this subject should be conducted to better explore the phenomenon and to determine the impacts of structural level effects, such as policy and timing of policy, on student food security.

4.5. Novelty

Despite the limitations, this study is just one of several to look at the impacts of the COVID-19 pandemic on student food security by

quantifying food security both before and during the pandemic. Narrowing even further, it is one of only a few that looks at both change in food insecurity rate and change in food security status. Furthermore, it is the only one of these studies to assess the number of quarters students moved back in with family (rather than a yes/no response), which yields valuable additional knowledge. Similarly, in assessing food insecurity change for students who were living at home before the pandemic, the study provided valuable knowledge about food insecurity in the college student population prior to students attending college. Last, the time frame of assessment used in this study was longer than in other studies, which allows for a more extensive understanding of the impacts of the pandemic throughout its entire duration.

5. Conclusion

This study shows that the rate of food insecurity generally increased during the COVID-19 pandemic and that while food security status improved for some students, it declined for others. The major drivers of this divergence were 1) the amount of time that students moved back in with their families and 2) whether or not student's lost employment. While moving back in with family led to a better food security status for many, it was not a panacea, as food insecurity rates were still quite high for students who did so. This study also revealed that respondents had a high rate of food insecurity in the year prior to attending college, indicating a high rate of household food insecurity in the general population which sends students to the university. This group also had one of the greatest increases in food insecurity rate during the pandemic, emphasizing the need to target this group for interventions during future pandemics. The results of this study also demonstrate the necessity of looking at both change in food insecurity rate and change in food security status in studies of this nature. Though closely related, they provide unique insights into the dynamic impacts of the pandemic. Future research will examine the determinants of students moving home to better understand who will be negatively impacted by future pandemics and to develop appropriate policy responses, both at the government and college level. Last, to help relieve food insecurity during future pandemics, college and university basic needs programs should expand to meet the greater need and should advertise services and make services accessible outside of the campus area to assist students living in their hometowns.

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Ethical statement

All study participants provided informed consent and the study was approved by the Human Subjects Institutional Review Board where the research was conducted (IRB# 20-21-0194).

CRediT authorship contribution statement

Corbin Hodges: Conceptualization, Data curation, Formal analysis, Funding acquisition, Methodology, Project administration, Supervision, Writing – original draft, Writing – review & editing. **Stuart Sweeney:** Data curation, Formal analysis, Supervision, Writing – original draft, Writing – review & editing.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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