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Oregon State University Food Security Study ECampus

OSU DIVISION OF STUDENT AFFAIRS
FOOD INSECURITY TASKFORCE
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Executive Summary

Food insecurity (FI) is a growing concern on college campuses. As requested from the Oregon State University (OSU) Food Insecurity Taskforce, this report on the OSU Ecampus outlines findings from the first formal study of the prevalence and patterns of FI among OSU students. Companion reports are available for the OSU Corvallis and Cascades campuses. During Winter term, 2021, FI was measured among Ecampus students using the United States Department of Agriculture (USDA) 10-item Food Security Survey Module (FSSM) with a 2-item food sufficiency screener, delivered via a campus-wide email invitation to a voluntary online survey. The findings of this study can help to inform the University's plan to ensure equitable food access among all students.

This report on the OSU Ecampus study provides background on the issue of college student FI, both broadly and within the context of the COVID-19 pandemic during which the survey was completed. A detailed description of the methodology used to estimate FI among OSU students is provided, followed by Ecampus results, including the indicators and patterns of FI among specific student sub-populations. The report concludes with a discussion of the findings, including the study's limitations and recommended areas for future research on this topic.

Our findings indicate that approximately 39.5% of the OSU Ecampus student population is food insecure. The companion reports on Corvallis and Cascades reveal an important finding regarding sampling methodology, which is also relevant to the analysis of the Ecampus data. Sampling of students using a campus-wide email may overestimate the prevalence of FI due to non-response bias. The student FI rate from course visit samples at Corvallis and Cascades was lower (about 24 - 25%) compared to campus-wide email samples (about 32 - 47%). Thus, we suspect survey results obtained by the same email sampling method among Ecampus students are also subject to inflation as a result of non-response bias. If the Corvallis pattern holds for Ecampus, a more accurate FI rate for Ecampus may be ten percentage points lower, around 30% rather than 39.5%.

Among OSU Ecampus students, FI varies across groups. Rates differ by college and class standing, with first- and second-year undergraduates being far less food secure than graduate students. Status as a first-generation college student is associated with a significantly higher risk of FI. Asian, American Indian and Alaska Native, and multiracial students, as well as female and non-binary gender identifying students, are also at higher risk for FI. Participation in aid programs that rely on income qualification including Pell Grant, Work-Study funding, and SNAP is also associated with FI risk. The likelihood of being food insecure is significantly lower for students living with a spouse or partner, or those living outside the U.S. These findings indicate some unique influences on FI within the Ecampus population compared to the other OSU campuses.

This study corroborates other research indicating that college students are particularly vulnerable to FI while providing specific insight regarding those attending college through an online campus. These findings also highlight that prevalence of FI is unequally distributed among OSU student sub-populations, with some students at higher risk of FI. While an online campus presents certain limitations in addressing FI, these findings can be used to promote equitable and targeted initiatives available to Ecampus students and particularly for those most vulnerable to FI.

Background

In Fall 2019 and Winter 2020, the Oregon State University (OSU) Food Insecurity Taskforce convened to address food insecurity at OSU. A recommendation of the Taskforce was to first assess the prevalence of food insecurity among OSU students. With funding from the OSU Division of Student Affairs and the School of Public Policy's OSU Policy Analysis Lab, Clinical Assistant Professor Jenny Jackson and Professor Mark Edwards assembled a research team including eight undergraduate and graduate students to conduct an innovative survey starting with the Corvallis campus in the Fall term of 2020, then the Cascades campus and Ecampus in the Winter of 2021.

Food Insecurity

Food insecurity (FI) is defined as the inability to access an adequate supply of food due to a lack of money or additional resources. Food insecure households may be further categorized as having low food security (problems acquiring food leading to reduced diet quality) or very low food security (inability to afford food to the degree of multiple instances of reduced food intake) (Coleman-Jensen et al., 2020). Food insecurity is known to vary by subgroup within the population nationally, with higher prevalence in households with children, adults living alone, households headed by Hispanic or Black persons, and households with income levels less than 185% of the U.S. poverty threshold (Coleman-Jensen et al., 2020). The prevalence of FI in the general U.S. population was 11.1% in 2019 with significant differences by location, state-level rates ranging from a low of 7.8% to a high of 16.8% and lower levels in the Northeast (10.2%) and higher levels in the South (12%) (Coleman-Jensen et al., 2020). The COVID-19 pandemic drove FI up nationally, with an estimated 13.9% of U.S. households food insecure in 2020 and a predicted 12.9% in 2021. Expected disparities will result in even higher rates in rural counties, and in Black, Latinx, and Native American households (Feeding America, 2021).

Variability in Food Insecurity Across Institutions

Pre-pandemic estimates of the prevalence of FI among college students ranged from 9% to well over 50% (Larin, 2018). In 2014, a study at Western Oregon University reported 59% of the student body was food insecure (Patton-Lopez et al., 2014). In 2017, a review of FI in postsecondary education settings in the U.S. found an average FI rate of 32.9% (Bruening et al., 2017). The high level of variation among estimates of FI in higher education can be largely attributed to study methodology, particularly survey modality and sampling design (Nikolaus, Ellison & Nickols-Richardson, 2020; Nikolaus, Ruopeng, Ellison, & Nickols-Richardson, 2020). Surveys present inherent obstacles for validity and accuracy related to human responses, sampling representativeness, and generalizability. Nonetheless, surveys are the only method available to assess FI in populations of students, suggesting that careful attention must be given to improving external validity.

Concerns regarding FI survey validity may be exacerbated by the context of a college campus (Nikolaus, Ellison, & Nickols-Richardson, 2019a; Nikolaus, Ellison, & Nickols-Richardson, 2019b). Some limitations related to using standard FI surveys in the college setting include students' differing interpretations of FI questions (Nikolaus, Ellison, & Nickols-Richardson, 2019a), varying campus dining plans and practices (Van Woerden et al., 2019), and difficulty quantifying students' financial resources (Carnevale et al., 2015) and parental support (Nikolaus, Ellison, & Nickols-Richardson, 2019a). Additionally, college student FI rates reported by campus

surveys have shown differences based on the timing of the survey within both the school term (Van Woerden et al., 2019) and the school year (Riddle et al., 2020), as well as the type of campus when comparing online, metropolitan, and suburban campuses (Moore et al., 2020; Owens et al, 2020). Research on college student FI also lacks the inclusion of non-urban colleges, as well as historically Black institutions and Hispanic-serving schools, and limited sampling of many groups including non-traditional students, graduate students, and students with backgrounds who are historically underserved (Bruening et al., 2017).

Research shows the prevalence of FI is greater among some groups of students, with race, ethnicity, parenting status, living arrangement, and income level demonstrating a relationship with FI in the college student population (Baker-Smith et al., 2020; Owens et al., 2020; Soria et al., 2020). In college students, gender identity and sexual orientation also have shown a correlation with FI (Baker-Smith et al., 2020; Owens et al., 2020; Riddle et al., 2020; Soria et al., 2020). Additionally, college students' year of study and first-generation status have been associated with FI (Owens et al, 2020; Riddle et al., 2020; Soria et al., 2020).

COVID-19 and College Student Food Insecurity

An examination of FI at several universities during COVID-19 found average FI rates of 22% among undergraduates and 19% among graduate students, with rates reaching greater than 30% in many historically marginalized and underrepresented groups (Soria et al., 2020). Goldrick-Rab et al. (2020) report in their study of multiple colleges an overall increase in FI rates from 33% to 38% between Fall of 2019 and Spring of 2020. Soldavini et al. (2020) report that at one university the 10.8% rate of FI in Winter 2020 grew to 14.5% in the months following the onset of the pandemic.

Research Goals

These data are intended to inform OSU's strategies to ensure equitable food access among students, both in terms of the current COVID-19 pandemic response and long-term interventions on campus. This report provides information about students primarily affiliated with the OSU Ecampus. Separate reports have been completed for OSU's Corvallis and Cascades campuses.

Methodology

The United States Department of Agriculture (USDA) defines ranges of food insecurity including "food security" and "food insecurity," with the second category further refined as "low food security" and "very low food security." The USDA FSSM is a validated, widely used instrument for measuring food security and is available in multiple forms (USDA, 2020). The survey used to assess the prevalence of FI among OSU students consisted of the USDA 10-item Food Security Survey Module (FSSM) with a 2-item food sufficiency screener, determined to be the most accurate survey currently available for determining FI among college students (Nikolaus, Ellison, & Nickols-Richardson, 2019a). This survey is displayed in Table 1. Individuals were categorized as FI if they responded affirmatively to 3 or more items; otherwise, they were categorized as food secure. For our purposes of better understanding which groups of students were more likely to be food insecure, the survey also included questions about student demographics, financial aid, and living situations. These questions also allow for comparison with surveys conducted for the OSU Corvallis and Cascades campuses. Additional questions were added for the Ecampus survey regarding age and living locations outside of Oregon or the United States due to greater variability in age and residency outside the state.

Unlike the Corvallis and Cascade campus studies, the Ecampus survey was solely administered through email. Details on the methodology for course visit sampling at the other campuses can be found in their corresponding reports.

Survey data were collected online via Qualtrics. The survey was emailed by the OSU Ecampus administration to the entire Ecampus campus student body. Only those students who had the DSC campus code in Banner, indicating Ecampus as their campus, when the survey was administered were emailed. OSU students affiliated with other campuses who were enrolled in an Ecampus course did not receive the invitation to participate in this version of the survey. Entry into a raffle for one of two $100 gift cards was offered for survey participation as an incentive. Data were de-identified and stored separately from the student information collected for the $100 gift card raffle.

Table 1: The USDA 10 item FSSM with a 2-item screener[1]

Question/Item	Affirmative Response (indicating insecure)	Negative Response (indicating secure)
2 – item Food Sufficiency Screener		
In the last 30 days, did you ever run short of money and try to make your food or your food money go further?	Yes	No
Which of these statements best describes the food eaten in your household?	Enough but not always the kinds of food we want to eat, Sometimes not enough to eat, Often not enough to eat	Enough of the kinds of food we want to eat
10 – item USDA Food Security Survey Module		

I worried whether my food would run out before I got money to buy more.	Often true, Sometimes true	Never true, Don't know
The food that I bought just didn't last, and I didn't have enough money to get more.	Often true, Sometimes true	Never true, Don't know
I couldn't afford to eat balanced meals.	Often true, Sometimes true	Never true, Don't know
In the last 30 days, did you ever cut the size of your meals or skip meals because there wasn't enough money for food?	Yes	No, Don't know
In the last 30 days, how many days did this happen?	≧ 3 Days	1 – 2 Days
In the last 30 days, did you ever eat less than you felt you should because there wasn't enough money for food?	Yes	No, Don't know
In the last 30 days, were you ever hungry but didn't eat because there wasn't enough money for food?	Yes	No, Don't know
In the last 30 days, did you lose weight because there wasn't enough money for food?	Yes	No, Don't know
In the last 30 days, did you ever not eat for a whole day because there wasn't enough money for food?	Yes	No, Don't know
In the last 30 days, how many days did this happen?	≧ 3 Days	1 – 2 Days

[1]Respondents with 3 or more affirmative responses were categorized as food insecure. Respondents with 6 or more affirmative responses were further categorized as having "very low food security."

Results

A total of 794 survey responses were received between March 1 to March 31, 2021. After removing incomplete responses, a total sample size of 779 was reached; a 6.3% response rate. Survey responses were classified as "missing" if a respondent did not complete the 2-item screener or, if applicable, the 10-item FSSM for categorizing food security status. In cases where a respondent completed the 10-item FSSM but did not provide further demographic or personal information, their food security status was included, and all remaining data were coded as missing. For this reason, the number of observations (N) varies when looking at subpopulations.

Campus-wide Findings (Ecampus)

Table 2 presents the prevalence of FI among OSU Ecampus students. Results indicate that 39.5% of survey participants were food insecure in March 2021.

Table 2: Food Insecurity Prevalence (%) among OSU Ecampus students[1]

Demographic characteristic	FI (%)	N[2]
All Participants	39.5	779
Class Standing		
Frosh/Soph	54.1	98
Jr/Senior+	41.1	516
Graduate - Masters	26.9	119
Graduate - PhD	21.2	19
Age		
18-24 years	50.4	125
25-34 years	38.5	353
35+ years	36.7	264
College		
Agricultural Sciences	44.9	227
Business	52.3	44
Education	38.8	49
Science	50.9	53
Liberal Arts	37.1	159
Public Health and Human Sciences	45.2	42
Earth, Ocean, and Atmospheric Sciences	53.8	39
Veterinary Medicine or Pharmacy	0.0	2
Engineering	17.9	117
Student Type		
Part-time enrollment[3]	33.5	520
Full-time enrollment	54.2	238
First-generation college status		
First-generation college student	48.8	367
Not first-generation college student	30.1	378
Race/Ethnicity		
White or Caucasian	36.9	528
American Indian or Alaska Native	71.4	7
Asian	27.9	43

Black, African American, African diaspora	30.8	13
Latinx or Hispanic	44.7	38
Native Hawaiian or Pacific Islander	50.0	6
Multiracial / Two or more	55.1	78
BIPOC[4]	45.1	184
Gender		
Female	42.2	503
Male	29.7	199
Nonbinary	71.4	28
Transgender[5]	87.5	8
Funding		
Pell Grant	59.2	201
Work-study	58.3	24
Other funding	40.7	59
Graduate Funding	12.5	24
No funding	38.2	306
SNAP		
Has been on SNAP within the past year	73.6	91
Currently on SNAP	80.0	55
Never on SNAP within past year	35.0	665
Employment		
Not currently employed	46.5	258
Currently employed	36.2	497
Living Situation		
Lives with children	39.7	239
Lives with family	41.9	215
Lives with spouse/partner	35.2	458
Lives in local county	47.7	65
Lives in Oregon	44.7	228
Lives in a state other than OR	38.1	494
Lives outside of Oregon	37.4	513
Lives in the U.S.	40.4	725
Lives outside the U.S.	21.1	19

[1] We reviewed the representativeness of our sample but did not apply weights because the use did not substantially change the results. Representativeness is displayed in Appendix B.
[2] Sub-sample sizes do not always sum to the total number of participants due to some incomplete surveys.
[3] Students are considered part-time if enrolled in less than 12 credits per term and full-time if enrolled in 12 or more credits.
[4] The BIPOC category includes respondents who identified as a student of color including those who identified as multiracial and those who identified with a single race.
[5] We include all respondents who indicated identifying as transgender, including those who also indicated female or male, meaning this category is *not* exclusive

The results found in Table 2 demonstrate some patterns of college student FI that are expected in groups typically more vulnerable to FI. Undergraduate students reported a higher rate of FI than graduate students. Differences were seen between races/ethnicities with students who identified as American Indian/Alaska Native, Latinx/Hispanic, Native Hawaiian or Pacific Islander or

multiracial reporting higher rates of FI. Students classified in the BIPOC category showed a FI rate 8 percentage points higher than White students. These racial and ethnic differences are suggestive of likely real differences, but small sample sizes limit the ability to establish statistical significance ($p<.05$). However, other differences are large and statistically significant. For example, nearly half of students who are first-generation college students reported being food insecure, a rate 18 percentage points higher than among students who were not classified as first-generation to attend college. Gender differences are also noteworthy with the lowest rates of FI reported by those identifying as males who have a rate 13 percentage points lower than females. Non-binary and transgender identifying students appear to have dramatically higher FI rates than other students.

Multiple factors related to income and aid were evaluated. Students reporting receipt of funding from Pell Grant and Work-Study programs reported rates of FI about 20 percentage points higher than students receiving no funding. Students who have received SNAP benefits within the past year or currently receive SNAP benefits had rates of FI more than twice that of students who have not participated in SNAP within the past year.

Below we examine in greater detail patterns of FI among specific groups.

Table 3 shows how each demographic characteristic was associated with FI, accounting for the other variables measured. This table reports adjusted odds ratios, or the likelihood of being food insecure given that a respondent is in a specific demographic group while controlling for other factors.

Table 3: Adjusted odds of food insecurity among Corvallis OSU students, 2020

Variable	AOR[1]
Class Standing	
Frosh/Soph (referent)	
Jr/Senior+	0.77
Masters	0.45**
Doctorate	0.28
College[2]	0.88***
Credit Hours	
Part-time (referent)	
Full-time[3]	1.20
Race/Ethnicity	
White (referent)	
American Indian or Alaska Native	6.00*
Asian	1.49
Black, African American, African diaspora	0.83
Latinx or Hispanic	1.43
Native Hawaiian or Pacific Islander (NHPI)	1.92

Multiracial / Two or more	1.87**
First-Generation College Student Status	
Not a first-generation student (referent)	
First-Generation College Student	1.51**
Gender[4]	
Male (referent)	
Female	1.39
Nonbinary	3.29**
Transgender	1.81
SNAP Status	
No SNAP past year (referent)	
Currently on SNAP	1.60
History of SNAP receipt past year	2.75***
Funding	
No funding (referent)	
Reported Pell Grant	1.44*
Reported Work-Study	0.58
Living arrangement [5]	
Lives with spouse/partner	0.65**
Employment	
Not employed (referent)	
Employed	0.81
Living location	
Lives in Oregon	1.00
Lives in the U.S.	3.42**
Age	0.78*
Constant	0.44
N[6]	675

legend: * p<.1; ** p<.05; *** p<.01

[1]Adjusted odds ratios are adjusted for all variables that were significant in univariate analyses of food insecurity on a 90% confidence interval (class standing, credit hours, college, first-generation status, gender, race/ethnicity, living situation, and location, and SNAP receipt).

[2] The significance of this variable does not indicate that College affiliation causes food insecurity but reveals where food insecure students may be concentrated. Further evaluation and interpretation can be found in subsequent sections and Appendix C.

[3] Refers to Full-time credit enrollment. Students are considered part-time if enrolled in less than 12 credits per term and full-time if enrolled in 12 or more credits.

[4] The “female” and “male” categories include all respondents who identified as “female” or “male,” including those who also identified as transgender. The transgender variable is a binary variable indicating if a respondent selected “transgender” as a gender identity whether in conjunction with other identities such as male or female or independently.

[5] The referent category for each of the variables within "Living arrangements" and "Living location" is the opposite, such as "Does not live with spouse/partner."
[6]The sample number does not include those respondents with incomplete surveys. Respondents were only able to complete the survey once.

Food Security by Class Standing and College

Both Class Standing and College were associated with food security status. Table 2 shows that undergraduate students, particularly first and second-year undergraduates, reported higher rates of FI than graduate students. Table 3 shows that the relationship is statistically significant even when other variables are taken into account. For example, a master's level student is about 61% less likely to be food insecure than a first- or second-year undergraduate student, while a doctoral student is about 77% less likely.

Our analysis also indicates that the college in which a student is enrolled is correlated with FI. Table 2 shows how rates of FI vary greatly across colleges from 0% to 53.8%. Although College appears to be significantly associated with FI (Table 3), this is not a causal relationship. College-level differences in food insecurity are undoubtedly closely related to college differences in the demographic and income characteristics of students in those colleges, though our data are unable to identify specific explanatory variables. Appendix C explores this issue in more depth.

Food Security by First-generation College Status

First-generation college status appears to be a significant driver of FI among Ecampus survey respondents. Those who identified as first-generation college students were 50% more likely to be food insecure than students with a parent who had a college degree (Tables 2 and 3).

Appendix D further explores the relationship between first-generation status and FI. While controlling for variables such as race, class standing, and SNAP receipt dampens the magnitude of this relationship, it remains significant until adjusted for Pell Grant receipt. This finding indicates that both variables, the first-generation status variable, and the Pell Grant variable, could be measuring financial hardship among students and their parents.

Food Security by Race and Ethnicity

FI appeared to vary greatly by race and ethnicity (Table 2). The rate of FI for different race and ethnic groups ranged from 28% to 55%, with the exception of Native American students showing an exceptionally high rate of 71% (note: the small sample size (n=7) for this group indicates further examination is needed).

Appendix D further shows how race impacts the likelihood of FI independently as well as when controlling for other variables such as first-generation college status and SNAP receipt. Table D-1 illustrates how the direction of impact can change depending on which covariates are included in the model. For example, when race alone is considered, students who identified as Asian or as Black were less likely (37% and 27%) to report being food insecure. However, when class standing is adjusted for, both Asian and Black students appear more likely to be food insecure than their White counterparts, while other racial/ethnic groups' likelihood of being food insecure stayed consistent. In the full model, which accounts for other variables that were significant in

univariate analyses (Table 3), being American Indian or Alaska Native, Asian or Multiracial appear to be significantly associated with FI.

Food Security by Gender

Female students showed an FI rate 12.5 percentage points higher than male students (Table 2). When other variables were taken into account, including first-generation status and use of SNAP, the correlation diminished but was not fully explained away, suggesting that female Ecampus students' higher FI rates are at least partially due to higher rates of economic hardships (indicated by first-generation status and/or past SNAP receipt) (Table F-2).

Our findings also suggest that students who identify as non-binary are 4.2 times more likely to be food insecure than male students (Table 3). We interpret this finding with caution because our sample of respondents who identified as non-binary or transgender is very small. Table 4 displays the rates of FI among all possible categories of gender.

Appendix F further investigates the relationship between gender and FI.

Table 4: Frequencies and FI rates by gender identity

Gender Identity	Frequency	FI rate (%)
Agender	3	66.7%
Man	198	29.3%
Man, Non-binary	1	100.0%
Man, Transgender, Non-binary	1	100.0%
Non-binary	9	55.6%
Prefer not to disclose	21	42.9%
Prefer to self-describe	1	0.0%
Transgender	3	100.0%
Transgender, Non-binary	3	100.0%
Woman	502	42.2%
Woman, Non-binary	8	62.5%
Total	750	39.9%

Food Security by Funding, Support, and Employment

Students who received Pell Grants or Work-Study support have higher FI rates (Table 2). Similarly, students who have received SNAP within the past year showed a significantly higher prevalence of FI (Table 2), and this association was significant in the multivariate analysis (Table 3). The relationship between FI and SNAP participation or receipt of college funding may be due to a lower family or personal income level, making students eligible for both SNAP and federal college tuition aid.

Further analysis of these funding and support variables, which can be found in Appendix E, indicates that they are significantly associated with FI until participation in SNAP is controlled for in the analysis. Participation in federal Pell Grants and the Work-Study program is therefore not significantly associated with FI when accounting for participation in another low-income federal aid program. The underlying driver of FI here is financial hardship.

Employed students show lower FI rates than those not currently employed (Table 2), a finding corroborated in Appendix E (Table E-2), showing a statistically significant difference, with employed respondents being 35% less likely to be food insecure than students not currently employed. This association diminishes to statistical insignificance in more complex models (Table 3, Table E-2).

Food Security by Arrangements and Living Location

Living with a spouse or partner was significantly associated with FI. As shown in Table 3, respondents who live with a spouse or partner were less likely to be food insecure than respondents who did not live with a spouse or partner. Neither having other adult family members or children in their household was associated with food security status.

Ecampus students living in Oregon appear to be more likely to be food insecure than students living outside of Oregon (Table 2). This association is statistically significant when no other variables are considered, but diminishes when adjusted for other variables, especially gender and history of SNAP receipt (Appendix G, Table G-1). This indicates that the higher risk of FI among Ecampus students living in Oregon may be the result of a higher concentration of female students and students with a history of SNAP receipt within the population of Ecampus students who were Oregon residents in our sample.

Appendix G displays how FI varies across regions in the United States within our sample. When states outside of Oregon are grouped by U.S. Census regions, there were similar patterns compared to national household rates, with the highest prevalence of FI in the South and the lowest in the Northeast. Although, notably, the prevalence of FI reported in this study is much higher than the U.S. average perhaps in part due to students' unique vulnerabilities and in part due to the upward bias resulting from email surveying, as discussed above.

Respondents living in the U.S. were 5.58 times more likely to be food insecure than respondents living in other countries. Importantly, this variable was simply a measure of living location and not residency or immigration status. Students living outside the U.S. in this sample may consist of both U.S. citizens living abroad and students who are not from the U.S.

Discussion

The results of this study corroborate prior research that college students are particularly vulnerable to FI. The estimated FI prevalence of 39.5% for Ecampus students is dramatically higher than the recent national FI projections of 12.9% among U.S. households (Feeding America, 2021). FI also appears to be higher for OSU Ecampus students compared to those attending OSU's Corvallis campus (31.6%), based on recent surveys collecting data by the same campus-wide email method. Findings from the OSU Corvallis study provide valuable information about the degree to which surveys with email-based sampling may inflate FI estimates due to response-bias. If patterns from the Corvallis and Cascades campus hold, the true rate for Ecampus may be ten percentage points lower, around 30% rather than 39.5%.

Regional differences in the socioeconomic correlates of FI and the availability of supportive services for reducing food insecurity may, in part, contribute to these differences. Program options and tuition costs may also influence which students enroll in Ecampus programs. The majority of Ecampus students live outside Oregon. Because there are no added tuition costs for out-of-state Ecampus students as is the case for other OSU campuses, those with fewer resources may enroll in Ecampus over other OSU campuses. Moving out of state may result in higher financial costs including out-of-state tuition and the need to find new employment. Generally, however, Ecampus tuition by credit hour is slightly higher compared to in-state tuition for other OSU campuses, though Ecampus students do not incur student fees.

This survey of OSU's Ecampus provides insight into which groups are most at risk for FI. College and class standing are significant correlates of FI among the students surveyed. Considering class standing, frosh/sophomore students have a higher risk of FI compared to graduate students. The reasons for this are not clear but this finding highlights the need for interventions to help improve food access, particularly among undergraduate students. Some colleges within the university that have higher numbers of food insecure students may need to attend to the impacts of FI experienced by those students.

Ecampus students whose parents did not attend college (i.e., first-generation college students) were more likely to be food insecure, though the magnitude of this relationship was dampened after adjusting for other variables that measure financial hardship, such as participation in SNAP programs or receipt of Pell Grant. The literature suggests an association between education level and household income. Thus, first-generation college student status may be reflecting the influence of parents' lower-income level on students' risk for FI. The challenges first-generation students face in attending college need to be addressed with outreach that includes improving the ability to meet food needs.

Race and ethnicity are associated with FI among Ecampus students. Ecampus students who reported being American Indian or Alaska Native had the highest risk of FI in our sample, though the small sample size requires further study before drawing conclusions across the population. Students who identified as Asian also showed a higher risk of being food insecure than White students. Overall, disparities in FI are present in non-White students. This indicates a need for further and better understanding of racial inequalities and how student services can help to promote food security for all students.

Prevalence of FI differed by gender, with female and nonbinary students reporting higher rates than their male peers. This is consistent with prior research on college students (Baker-Smith et al., 2020; Riddle et al., 2020; Soria et al., 2020). The sample of non-binary students in our study showed an increased risk for FI. Our small sample of transgender (n=9) and non-binary (n=27) students indicates a need to further evaluate this subgroup of students on a larger scale to better understand and address disparities in this population. Female students showed higher rates of FI. The association of FI with being female was partially explained by resource constraints (first generation status and history of SNAP) (Appendix F, F-2).

There were several factors related to income that were associated with food security status. Those students who had received SNAP benefits at some point in the last year were at high risk for being FI. While this may indicate the program is not fully meeting their food needs, it is important to recognize that aid programs such as these are intended to help improve food access and not to completely eliminate FI among low-income households. SNAP targets individuals who are at risk for FI. Without this program, participants may face even greater difficulty obtaining enough food. As emergency measures that expanded SNAP benefits during the pandemic come to an end, there will likely be students who lose these benefits despite being food insecure. Historically, eligible college students often do not participate in SNAP. There are differences between states in their efforts to reach out to this population (Larin, 2018; Laska et al., 2021). Many low-income students are also ineligible for SNAP due to specific restrictions on college students, an issue that many see as contributing to the high rates of FI among college students and which indicates a need for program reform (Dunyak, 2018; Freudenberg, Goldrick-Rab, & Poppendieck, J.,2019). The recently proposed federal legislation to expand SNAP eligibility for college students was unsuccessful during the COVID-19 pandemic (Laska et al., 2020). Ecampus students living in Oregon were somewhat more fortunate than those in many other states due to Oregon's more generous interpretation of college-related rules for SNAP eligibility. In addition to directing food insecure students to government resources such as SNAP, which they may not qualify for, referrals to community resources such as food banks and education on meal planning and budgeting may be helpful for all OSU students.

An additional factor related to FI identified in the Ecampus survey is a student's living situation. For those students who live with a partner or spouse, their risk of FI was significantly lower compared to students who do not live with a partner or spouse. This difference may be especially important during the pandemic when having a partner may provide an additional income source for students who have lost income due to reduced work hours. This result could also be expected as adults living alone have been found to have higher rates of FI in the general U.S. population (Coleman-Jensen et al., 2020). Future research should look more closely at the nuances of living situations. In total, Ecampus students living with children or adult family members had a FI prevalence of about 40%. Ecampus' annual undergraduate survey found about 20% of students are a caregiver to children and 6% a caregiver to an adult family member. Outreach to improve food access in Ecampus students should consider referral to food resources that apply to students with families, including multigenerational households.

Differences in FI were not statistically significant between living locations except when comparing those living in the U.S. with those living in other countries. This question was unique to our Ecampus survey. Because the survey did not explore the national origin or residency status

of students living outside the U.S, we do not know if students who were located overseas are U.S. citizens or not. Additionally, data from the Office of Institutional Research indicates that approximately 9% of Ecampus students are military service members or are the spouse/dependent of a military service members. We also did not inquire as to the residency status of students living in the U.S. Our sample of students living outside the U.S. was small (n=19). Future surveys may assess how food security differs for international students living in the U.S. and those living outside the U.S.

Limitations and Future Improvements in Methodology

The research on FI among the OSU Ecampus student population has some notable limitations. Due to the nature of online asynchronous classes, the course visit sampling method which we believe is likely a more accurate estimate of FI prevalence was not completed for Ecampus as it was for the OSU Corvallis and Cascades campuses. The estimates of FI prevalence for Ecampus may be inflated due to non-response bias. In this case, food insecure students would likely be more motivated to participate.

The FI screener and questionnaire used in this survey focuses on a 30-day reference period when assessing the level of food security. However, FI is often an intermittent, recurring condition (Coleman-Jensen et al., 2020). This may especially be true during the COVID-19 pandemic. The prevalence of FI among Ecampus students as captured by this study represents a snapshot of those experiences within the month prior to administration of the survey but may not reflect student food security over a longer timeframe. Since this survey refers to the previous 30 days rather than the past 12 months, the overall degree by which the Ecampus student population experiences FI during the academic year in terms is assumed to be under-estimated in our results since additional students are likely to become food insecure at some point following the survey time period.

The overall prevalence of FI among OSU's Ecampus students appears to be higher than some of the recent studies on FI at college campuses as well as the OSU Corvallis campus. Many factors differ between online campuses and traditional college campuses and need to be considered when making these comparisons. While our surveys of FI among OSU's Cascades and Corvallis campuses mostly represent students living in Oregon and largely in the local counties surrounding those campuses, the majority of our Ecampus survey participants live in other states. There are regional differences in FI rates across U.S. states, and differences in influential factors like state minimum wage laws, local costs of living, and eligibility or benefit amount from state-administered aid programs such as SNAP and unemployment. Amid the COVID-19 pandemic, the overall contrasting policy responses of state and local governments to the pandemic may have also influenced FI among our sample of Ecampus students living across the country. These socioeconomic and public policy differences highlight the challenges in addressing FI among college students which requires both state and national level interventions.

There have been few studies of college students specifically including the prevalence of FI for online campuses (Moore et al., 2020; Owens et al., 2020), and they provide few demographics for their online student samples. This leaves us with a limited ability to contrast our results with other online universities. The pandemic in 2020 also led to a jump in Ecampus enrollment for OSU and fewer out-of-state or international students enrolled at the Corvallis campus (Nealon, 2020). Ecampus' student demographics may therefore have shifted during this time. Without a prior

baseline of FI prevalence for OSU Ecampus, our results should be considered in the context of this timeframe. Further surveys should be conducted on FI for OSU Ecampus as well as other online college programs across the country to provide broader insight into the risk factors specific to this population.

While greater protection from FI when living with a partner or spouse was observed in this study, this does not fully explain the relationship between living situation and household FI. The format of classes at Ecampus can attract the non-traditional student, such as someone who is a caregiver for children or adult family members. Our survey did not examine the details regarding whether students living with adult family members are themselves still a dependent of their parents or whether they are a caregiver to children or adults in their household. Exploring this information in future surveys of FI may be especially useful to better understand how household living situations impact FI for Ecampus, which more often enrolls non-traditional college students.

Our small sample sizes of subpopulations introduce limitations in data analysis as well as interpretation. This is particularly true concerning students of color and students who identify as nonbinary or transgender. These small sample sizes prevent us from obtaining meaningful statistics or observing nuances in the relationship between race and FI or gender and FI. Furthermore, our sample disproportionately represents female students, which may impact the estimates and evaluation of other covariates.

There are also limitations to interpreting the results of international students' FI status. Our analysis was limited to Ecampus students who reported living outside the U.S. We did not ask about the immigration status of those students living in the U.S. There is some evidence that international students attending college in the U.S. face a higher risk of FI (Soldavini, Berner, & Da Silva, 2019). Questions regarding residency/immigration status may be sensitive in nature, but further exploration of this topic could help to understand the needs of OSU's international students. There are unique circumstances related to immigration status for both students living abroad and international students living in the U.S. that can impact FI such as the ability to obtain legal employment and access to aid programs. Collaboration with the OSU Office of International Services and Ecampus to measure differences related to these factors is recommended for future assessments of FI among OSU students.

Appendices

Appendix A: Food Security Survey – Ecampus

The results of this survey will help OSU improve the health and well-being of all our students. Your participation, whether or not you have had any difficulty accessing enough food, will help us to understand the problem of food insecurity at OSU.

This survey should take approximately 5 minutes to complete.

Before getting started, please review and consider the following consent information.

Consent

Purpose: The purpose of this study is to evaluate which groups of students are more or less food secure, particularly during the current COVID lockdown. We are surveying students to ask them about their level of food security (i.e. access to sufficient quantity of affordable, nutritious food), their current circumstances such as living situation, their economic security, and their receipt of public program help. We are interested in the entire student body at Oregon State University.

Eligibility requirement: To be eligible to participate in this study, you must be currently enrolled in a course offered by Oregon State University. You must also be at least 18 years of age.

Activities: We ask you to complete an online survey about your current circumstances related to food security, living situation, and economic security. This should take less than 5 minutes. At the end of the survey, you will be given the opportunity to submit your ONID email to enter a drawing for one of two $100 gift cards.

Voluntary: You do not have to be in the study if you do not want to. Participation in this survey will not influence your grade in any courses in which you are enrolled nor impact your standing with the university. Data collected from this survey will not be used for any future research outside of this context.

Risks: We don't anticipate any risks or discomforts with this study. Know that you may stop the survey at any time or refuse to answer any question. Data collected from this research will not be stored for future research.

Benefit: This study is not designed to benefit you directly, however, the research content and the materials we provide may be supportive and informational to you.

Confidentiality: Other people may learn that you participated in this study but the information you provide will be kept confidential to the extent permitted by law. Should you choose to provide your ONID email at the end of the survey, it will not be linked to your responses.

Study contacts: For more information about this study, please contact the principal investigators, Mark Edwards or Jenny Jackson, by phone at 541-737-5379 or 541-737-4853 or by email at medwards@oregonstate.edu or Jenny.Jackson@oregonstate.edu.

You can also contact the Human Research Protection Program with any concerns that you have about your rights or

welfare as a study participant. This office can be reached at (541) 737-8008 or by email at IRB@oregonstate.edu.

For students residing in the European Union, questions regarding General Data Protection Regulations can be address to OSU's Data Protection Officer, Tom Ordeman at (541) 737-9800 or by email at dpo@oregonstate.edu.

	Yes	No
I am at least 18 years of age or older	○	○
I currently attend OSU (in-person, remote, or online)	○	○
I agree to participate in this survey	○	○

The focus of this study is on the food security situation of students attending OSU. Even if you have had no difficulties obtaining food, we ask you to complete the following section to help us understand the food security of all OSU students.

In the last thirty (30) days, did you ever run short of money and try to make your food or your food money go further?

○ Yes

○ No

Which of these statements best describes the food eaten in your household?

○ Enough of the kinds of food we want to eat

○ Enough, but not always the kinds of food we want

○ Sometimes not enough to eat

○ Often not enough to eat

Thinking about the last thirty (30) days, please select whether the following statements were often true, sometimes

true, never true, or if you **don't know**.

In the last 30 days...

	Often true	Sometimes true	Never true	Don't know
I worried whether my food would run out before I got money to buy more.	○	○	○	○
The food that I bought just didn't last and I didn't have enough money to get more.	○	○	○	○
I couldn't afford to eat balanced meals.	○	○	○	○

For the following statements, please indicate whether you have experienced the following situations in the last thirty (30) days by selecting **yes, no,** or **don't know.**

In the last 30 days...

	Yes	No	Don't know
Did you ever cut the size of your meals or skip meals because there wasn't enough money for food?	○	○	○
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?	○	○	○
Did you lose weight because there wasn't enough money for food?	○	○	○
Did you ever not eat for a whole day because there wasn't enough money for food?	○	○	○

You indicated that sometimes you would skip meals or didn't eat for a whole day. About how many days did this happen in the last thirty (30) days?
(Click and drag the slider to indicate the approximate number of days each of the following occurred)

	0 5 10 15 20 25 30
I cut the size of my meals or skipped meals ()	
I didn't eat for a whole day ()	

Have you received SNAP benefits *(i.e. "food stamps")* in the past year?

- ◯ Yes
- ◯ No
- ◯ I'm not sure

Do you currently receive SNAP benefits?

- ◯ Yes
- ◯ No

To help us better understand who struggles with food security, and to ensure this survey is representative of the OSU student population, the following section will ask you a few questions about your academic progress, personal identity, and current living situations.

How many credit hours are you currently registered for? (Winter Term)

- ◯ 1 - 6 credits
- ◯ 7 - 11 credits
- ◯ 12 - 16 credits
- ◯ 17+ credits

Which type of student best represents you?

- ○ Undergraduate student
- ○ Post-baccalaureate student
- ○ Masters student
- ○ Doctoral student

Which College are you in?

- ○ Agricultural Sciences or Forestry
- ○ Business
- ○ Education
- ○ Engineering
- ○ Science
- ○ Liberal Arts
- ○ Public Health and Human Sciences
- ○ Earth, Ocean, and Atmospheric Sciences
- ○ Veterinary Medicine or Pharmacy

Do you receive institutional funding that pays for your tuition? (e.g. GTA/GRA, Fellowship, Fulbright, government scholarship).

- ○ Yes, all of my tuition is covered.
- ○ Yes, but only some of my tuition is covered.
- ○ No

What year are you in your undergraduate studies?

- ◯ 1st year
- ◯ 2nd year
- ◯ 3rd year
- ◯ 4th year+

Please select the following institutional support systems that apply to you. *(select all that apply)*

- ◯ I receive a Federal PELL Grant
- ◯ I qualify for "Work Study" programs
- ◯ Other *(please specify)*:

Are you employed this term?

- ◯ Yes
- ◯ No

About how many hours per week do you work?

- ◯ 1 - 9 hours
- ◯ 10 - 19 hours
- ◯ 20 - 29 hours
- ◯ 30+ hours

What is the highest level of education of any of your parents or guardians?

- ◯ Less than a high school diploma
- ◯ High school diploma or GED
- ◯ Some college or associate/ trade degree
- ◯ Bachelor's degree
- ◯ Master's degree or higher
- ◯ Don't know

What racial/ethnic backgrounds do you identify with? *(Select all that apply)*.

- ◯ American Indian or Alaska native
- ◯ Asian
- ◯ Black, African American, African diaspora
- ◯ Latinx or Hispanic
- ◯ Native Hawaiian or Pacific Islander
- ◯ White or Caucasian
- ◯ Prefer not to disclose
- ◯ Prefer to self-describe_____

What gender(s) do you identify with? *(Select all that apply)*.

- ◯ Woman
- ◯ Man
- ◯ Transgender
- ◯ Agender
- ◯ Non-binary
- ◯ Prefer not to disclose
- ◯ Prefer to self-describe

What is your age?

- ◯ 18-24 years
- ◯ 25-34 years
- ◯ 35+ years
- ◯ Prefer not to disclose

Do any children *(under 18)* currently live in your household?

- ◯ Yes
- ◯ No
- ◯ Prefer not to disclose

Do any adult family members currently live in your household? *(e.g. parents, grandparents, siblings)*

- ◯ Yes
- ◯ No
- ◯ Prefer not to disclose

Do you currently live with a spouse or partner?

- ◯ Yes
- ◯ No
- ◯ Prefer not to disclose

Are you currently living in the United States?

- ◯ Yes
- ◯ No
- ◯ Prefer not to disclose

Are you currently living in Oregon?

- ◯ Yes
- ◯ No
- ◯ Prefer not to disclose

What state do you currently live in?

○ _____ (select)

○ Prefer not to disclose

Do you currently live in the Corvallis/Albany/Eugene area? *(Benton, Linn or Lane County)*

○ Yes

○ No

○ Prefer not to disclose

Do you live on-campus this term?

○ Yes

○ No

Do you have an OSU dining plan this term?

○ Yes

○ No

Thank you for participating in this survey. Your responses will help us better understand food security at OSU and in our student population. Your answers and identity will remain confidential.

The following question will ask you if you would like to enter the drawing for one (1) of two $100 gift cards. To protect your privacy, if you select "Yes", you will be redirected to a new survey which will ask you to input your ONID e-mail address. *(Make sure you have pop-ups enabled in your phone or computer browser!)*

By collecting your e-mail in a different survey, we ensure your responses in this survey cannot be connected to your identity.

Would you like to enter the drawing for one of two $100 gift cards?
(Selecting "Yes" will redirect you to a new page).

- ○ Yes, please!
- ○ No, thank you.

Appendix B: Representativeness of Samples

Using data provided by the OSU Office of Institutional Research and OSU Ecampus, we analyzed the representativeness of our sample. Table B-1 displays the frequency and percentage of each subgroup in the sample population as well as the overall OSU Ecampus population and percentages. On many variables, the sample closely resembles known demographic information provided by E-campus. Female respondents are slightly over-represented in our sample. However, a 10 percentage point over-sample could only impact our overall estimates by fractions of a percentage point.

Table B-1: Representativeness of samples

Demographic characteristic	Total Sample N	Sample Percent	OSU Ecampus Pop	OSU Ecampus Percent
Class Standing				
Freshman	32	4.1%	343	3.9%
Sophomore	66	8.5%	733	8.3%
Junior	133	17.1%	1372	15.5%
Senior	208	26.7%	1947	22.0%
Post baccalaureate			2302	26.0%
Undergraduate[1]	439	56.4%	7059	79.9%
Graduate - Masters	119	15.3%	857	9.7%
Graduate - PhD	19	2.4%	124	1.4%
Prof PhD				
College				
Agricultural Sciences	227	29.1%	1794	14.5%
Business	44	5.7%	713	5.8%
Education	49	6.3%	386	3.1%
Science	54	6.4%	720	5.8%
Liberal Arts	159	20.4%	2086	16.9%
Public Health and Human Sciences	42	5.4%	1112	9.0%
Earth, Ocean, and Atmospheric Sciences	39	5.0%	553	4.5%
Veterinary Medicine or Pharmacy	2	0.3%	-	-
Engineering	117	15.0%	3118	25.3%
First-generation College Student Status				
First-generation	367	47.1%	3177	45%[2]
Credit Hours				
Part-time				
Full-time				
Gender[3]				
Female	503	64.6%		54.0%
Male	198	25.4%		46.0%
Nonbinary	28	3.6%	-	-

Transgender			-	-
Age				
18-24 years	125	16.0%	-	-
25-34 years	353	45.3%	-	-
35+ years	264	33.9%	-	-
Race and Ethnicity[4]				
White or Caucasian	534	68.6%	7917	64.2%
American Indian or Alaska Native	7	0.9%	74	0.6%
Asian	43	5.5%	925	7.5%
Black, African American, African diaspora	13	1.7%	321	2.6%
Latinx or Hispanic	38	4.9%	1221	9.9%
Native Hawaiian or Pacific Islander (NHPI)	4	0.5%	25	0.2%
Multiracial / Two or more	78	10.0%	641	5.2%
BIPOC	184	23.6%	3206	26.0%
Living Arrangements				
Lives with children	239	30.7%	-	-
Caregiver to children[5]		-	1405	19.9%
Lives with family		27.6%		
Caregiver to adult[5]	-	-	445	6.3%
Lives with spouse		58.8%	-	-
Lives on campus		0%	-	-
Lives in local county		8.3%	-	-
Lives in Oregon	228	29.3%	2590	21.0%
Participation in SNAP Food Assistance Program				
Received SNAP within past year	91	11.7%	-	-
Currently on SNAP	55	7.1%	-	-
No SNAP within past year	664	85.2%	-	-
Employment Status			-	-
Not currently employed	258	33.1%	-	-
Currently employed	497	63.8%	-	-

[1]Consistent with the Office of Institutional Research, we classified "post baccalaureate" students as "undergraduates."
[2]First-generation figures from the Office of Institutional Research include data for undergraduates only.
[3] Sample percent will not equal 100% due to non-exclusive categories and respondents who did not disclose gender identity.
[4] The race and ethnicity question allowed respondents to "check all that apply." Respondents were coded with a category if they *only* selected that race/ethnicity. If a respondent selected more than one category, they were coded as "Multiracial"
[5] "Caregiver to children" and "caregiver to adult family member" from UG annual student survey is not directly comparable to our survey question regarding children or adult family members living in one's household which may include children/adults for which they are not caregivers of such as younger siblings or non-dependent parent

Appendix C: Further Analysis of College and Class Standing

For class standing, first- and second-year undergraduates reported the highest rates of FI in our sample, and when comparing frosh/sophomore students with graduate students, the odds of FI were significantly reduced for both master's and doctorate students.

There were variances in FI risk when considering enrollment in specific colleges at OSU. This correlation remained significant for most colleges after controlling for class standing and full-time enrollment. Our data indicate that students in the colleges of Science, Business, and Education are particularly vulnerable to FI, while students within colleges of Liberal Arts This was a different finding from our surveys of Corvallis and Cascades campuses. When controlling for class standing, this eliminated the significance only for students enrolled in the College of Liberal Arts, and Veterinary Medicine at lower risks. These differences are only modestly explained by the demographics of students, as displayed in Table C, as we controlled for class standing, race, gender, funding, and SNAP status.

Table C: Association of College and FI (Adjusted Odds Ratio)

Variable	Association of College and FI	Class standing	Race	Gender	Pell Receipt	SNAP Receipt
College[2](College undisclosed as referent)						
Agriculture Sciences	3.73***	3.92***	3.77***	3.16***	2.84***	2.91***
Business	5.01***	5.70***	4.89***	4.32***	3.86***	3.47***
Education	2.90***	15.69***	13.97***	12.35***	10.80***	10.31***
Engineering	(omitted)	(omitted)	(omitted)	(omitted)	(omitted)	(omitted)
Science	4.75***	6.06***	5.59***	5.17***	4.39***	4.70***
Liberal Arts	2.70***	2.49***	2.24***	1.88*	1.58	1.64
Public Health & Human Sciences	3.78***	4.51***	4.14***	3.38***	2.66**	2.59**
Earth, Ocean, & Atmospheric Sciences	5.33***	5.27***	4.69***	3.77***	3.39***	3.41***
Veterinary Medicine	(omitted)	(omitted)	(omitted)	(omitted)	(omitted)	(omitted)
Class standing (Frosh/Soph as referent)						
Junior/Senior+		0.69	0.68	0.70	0.72	0.75
Graduate – Masters		0.17***	0.18***	0.18***	0.23***	0.24***
Graduate – PhD		0.05***	0.05***	0.03***	0.04***	0.04***
Race (White as referent)						
Native American or Alaskan			6.10*	7.32**	7.48**	7.06*
Asian			1.20	1.38	1.56	1.59
Black			0.70	0.86	0.91	1.04
Hispanic/Latino			1.60	1.79	1.82	1.76

[2] College of Veterinary and College of Engineering omitted due to multicollinearity. All observations within Veterinary Medicine were food secure. Univariate analysis of College of Engineering revealed lower odds of FI.

Pacific Islander or Hawaiian			1.16	1.43	1.81	1.96
Multiracial			2.08***	2.23***	2.12***	2.09**
First-Generation Status (not first-generation as referent)						
First-Generation			1.53**	1.47**	1.32	1.29
Gender (Male as referent)						
Female				1.42*	1.41	1.29
Nonbinary				3.22**	3.18**	2.78*
Transgender (cis as referent)				2.92	2.47	2.16
Funding (no reported funding as referent)						
Pell Grant Receipt					1.90***	1.56**
Work-study					1.13	0.80
SNAP Status (no receipt of SNAP in past year as referent)						
History of SNAP						2.54**
Current SNAP						1.75
Constant	0.22***	0.34***	0.25***	0.21***	0.19***	0.19***
N	730	725	711	692	692	689

Appendix D: Further Analysis of Race and First-generation College Status

Students who identified as Asian in our sample showed a higher risk of being food insecure than White students, which is consistent with our surveys of Corvallis and Cascades. However, this finding is in contrast to much of the literature on FI and race/ethnicity for U.S. households, which typically finds higher risk of FI among Black and Latinx/Hispanic households, including in recent research during the COVID-19 pandemic (Wolfson & Leung, 2020). There is research that indicates there are overlooked factors related to FI among Asian households in the U.S. due to a lack of homogeneity within the many subgroups often lumped together as "Asian" (Becerra, Kapella Mshigeni, & Becerra, 2018). The findings from our survey are an indication of the further variance of FI that can exist within this population. Asian college students may have different experiences than the population of Asian households within the U.S. which impacts food security status. It is possible that our sample includes more representation from those subgroups within the Asian identifier that are more food insecure in the U.S. such as those who are foreign-borne (Becerra, Kapella Mshigeni, & Becerra, 2018; Walsemann, Ro, & Gee, 2017) or Filipino (Cheong et al., 2019; Pia Chaparro, 2009) but because we did not collect data on those factors, we cannot be sure. This indicates a need for further research in this population.

The lower likelihood of FI among Black students (although statistically insignificant) offers an opportunity to explore further how race and other student characteristics could explain racial differences in FI (or lack of differences in this case.) One reasonable hypothesis would be that Black students enrolled in Ecampus may have higher social class and/or income characteristics compared to White Ecampus students, and quite different from Black students on traditional college campuses. While Black students on the Corvallis campus showed higher FI rates than White students, and this difference was explained by higher rates of first-generation status among Black students, it is possible that Black students in Ecampus are <u>less</u> likely than White students to be first-generation and perhaps have greater financial resources that prevent FI. We explored this possibility and found this hypothesis to be false -- the rate of first-generation status among the few (n=13) Black students was 54%, versus 47% for White students, a relatively modest difference, and opposite of the pattern hypothesized. A second hypothesis is that rather than resources per se, it is the student's class standing (graduate v. undergraduate) that could explain the unexpected finding. That is, the sudden shift in the correlation of being Black and experiencing FI, when class standing is included, may mean that Black Ecampus students are more likely to be graduate students, and once this association is taken into account, the apparent relationship between race and FI would appear to be more like what is seen on a traditional college campus. We examined this possibility and observed that 47% of Black Ecampus students in the sample are graduate students, while only 23% of White students are graduate students. Thus, there is at least circumstantial evidence for this second hypothesis. Of course, these findings should be interpreted with caution due to the small sample size of Black students (n=13) but these explorations suggest the need to remain attentive to potential explanations for racial and ethnic differences in FI among college students and to remain attentive to potentially unique processes that influence the characteristics of student populations served by different campuses.

Our study also showed that controlling for variables such as class standing impacted the relationship between FI and race and ethnicity. For example, when looking only at race and ethnicity, only American Indian and Alaska Native and multiracial status had a significant impact

on FI rates. However, the likelihood for FI when controlled for class standing reversed from lower to higher risk than White students in two groups – Asian and Black students. Here the class year rather than indications of household income (first-generation college status, SNAP status) were influential on racial/ethnic differences, a pattern inconsistent with our Corvallis sample. This may be an indicator of the greater income differences between undergraduate students and those more advanced in their careers attending graduate programs at Ecampus.

Table D-1: Racial Identity and FI (Adjusted Odds Ratio)

Variable	Association of Race and the likelihood of FI	Controlling for first-generation status	Controlling for SNAP status	Controlling for class standing
Race/Ethnicity (White as referent)				
American Indian or Alaska Native	3.78	3.67	3.41	3.91
Asian	0.64	0.68	0.76	0.79
Black, African American, African diaspora	0.73	0.70	0.86	1.02
Latinx or Hispanic	1.33	1.16	1.16	1.19
Native Hawaiian or Pacific Islander (NHPI)	1.65	1.65	2.01	1.66
Multiracial / Two or more	1.99***	1.82**	1.76**	1.74**
First-Generation College Student Status (Not a first-generation student as referent)				
First-generation College Status		2.08***	1.91***	1.81***
SNAP Status (Not on SNAP past year as referent)				
Has received SNAP within past year			3.04***	2.96***
Currently on SNAP			2.14	2.06
Class Standing (Frosh/Soph as referent)				
Jr/Senior+				0.66*
Master				0.38***
Doctorate				0.23**
Constant	0.608***	0.420***	0.36***	0.59**
N	747	741	738	734

* indicates a p-value< .1; ** indicates a p-value<.05; *** indicates a p- value<.01

Table D-2: First-generation College Status and FI (Adjusted Odds Ratio)

Variable	Impact of First-generation status on the likelihood of FI	Controlling for race	Controlling for class standing and enrollment	Controlling for SNAP	Controlling for Pell Grant
First-Generation College Student Status (Not a first-generation student as referent)					
First-generation College Status	2.15***	2.08***	1.89***	1.75***	1.63***
Race (White as referent)					
American Indian or Alaska Native		3.67	4.07	3.77	3.81
Asian		0.68	0.77	0.84	0.92
Black		0.69	0.83	1.00	1.02
Latinx or Hispanic		1.16	1.22	1.22	1.23
Native Hawaiian or Pacific Islander (NHPI)		1.65	1.40	1.80	1.94
Multiracial / Two or more		1.82**	1.74**	1.71**	1.67***
SNAP Status (Not on SNAP within past year as referent)					
Has received SNAP within past year				2.64***	2.46**
Currently on SNAP				2.17	2.08
Class standing (Frosh/Soph as referent)					
Jr/Senior+			0.66*	0.69	0.72
Masters			0.45**	0.48**	0.55*
Doctorate			0.26**	0.28*	0.32
Enrollment (part-time as referent)					
Full-time credits			1.91***	1.74***	1.58**
Funding (no reported Pell Grant as referent)					
Reported Pell Grant					1.53**
Constant	0.44***	0.42***	0.55***	0.47***	0.43***
N	745	741	737	734	734

* indicates a p-value< .1; ** indicates a p-value<.05; *** indicates a p-value<.01

Appendix E: Further Analysis of Funding and Employment

Given that Pell Grants and Work-Study eligibility would be based on the income of undergraduate students or their parents, the lack of significance these funding variables had after controlling for SNAP receipt, which relies also on income-based eligibility, indicates an expected relationship between lower-income and FI risk. While the prevalence of FI was higher among both those who reported having a history of SNAP and those currently on SNAP, this was only significant for the group "received SNAP within the past 12 months" in the multivariate regression. This variable includes both students who currently have SNAP and those who previously received SNAP. Current receipt of SNAP is also an indicator of lower-income and this was a significant correlate of FI risk in our Corvallis sample.

The receipt of SNAP within the past year being a stronger indicator of FI instead for Ecampus may be due to those students who lost SNAP benefits in our sample. Timing is also important to consider when evaluating FI in SNAP recipients, with greater food security reported at the beginning of the month (Gregory & Smith, 2019). Also, amidst the COVID-19 pandemic changes in SNAP have been implemented at the federal level to increase SNAP participation and the monthly allotment (Bitler, Hoynes, & Whitmore Schanzenbach, 2020). The SNAP program is administered with some discretions allowed by individual states and with our Ecampus sample representing students from 46 states these differences across states could account for our results.

Table E-1: Funding and FI (Adjusted Odds Ratio)

Variable	Funding	Controlling for College	Controlling for Race	Controlling for First-generation	Controlling for SNAP
Funding (No reported funding as referent)					
Reported Pell Grant	1.84***	1.75***	1.66**	1.60**	1.32
Work-study	1.24	1.30	1.29	1.30	0.86
Class Standing[1]		0.88	0.85	0.86	0.89
Credit Hours (Part-time as referent)					
Full-time		1.40*	1.44*	1.45*	1.34
College		0.94	0.94	0.94	0.94
Race (White as referent)					
Native American or Ala~n			1.77	1.70	1.35
Asian			0.53	0.53	0.56
Black			2.18	2.01	2.86
Hispanic/Latino			1.20	1.16	1.38

Pacific Islander or Ha~n			2.12	2.08	2.33
Multiracial			2.48***	2.34***	2.36***
First-generation College status (Not a first-generation student as referent)					
First-Generation				1.19	1.14
SNAP Status *(No SNAP past year as referent)*					
History of SNAP receipt					3.60***
Currently on SNAP					1.17
Constant	0.7750**	1.26	1.21	1.09	0.92
N	461	447	442	438	435

[1] Class standing is a categorical variable indicating where FI students are concentrated.

Table E-2 shows how controlling for the number of credits a student has enrolled in impacts whether employment is significantly associated with FI.

Table E-2: Employment status and FI (Adjusted Odds Ratio)

Variable	Employment	Controlling for age	Controlling for class standing	Controlling for credit enrollment
Employed *(Unemployed as referent)*	0.65***	0.63***	0.72**	0.81
Age		0.79**	0.87	0.92
Class Standing			0.70***	0.75***
Credit Hours[1]				1.47***
Constant	0.87	1.52	4.15***	1.20
N	755	742	738	738

[1] Credit hours is a continuous variable measuring the number of credits a student is enrolled in.

Looking closer at the impact of hours worked, Table E-3 displays how the relationship between employment and FI is only significant at 30 or more hours per week. This is a particularly important finding in the Ecampus study because it suggests that Ecampus students who are employed full-time or nearly full-time are less likely to be food insecure than students only working part-time while taking courses. However, this relationship becomes insignificant when we control for age, indicating that this relationship may be highlighting the difference between students who are mid-career and students who are younger and working less while in school.

Table E-3: Employment by hours working per week and impact on FI (Adjusted Odds Ratio)

Variable	Employment	Controlling for age
Hours working per week (Less than 10 hours/week as referent)		
10-19 hours/week	0.942	0.86

20-29 hours/week	1.20	1.16
30+ hours/week	0.50*	0.51
Age		0.75**
Constant	0.92	1.74
N	494	489

Appendix F: Further Analysis of Gender Identity

Table F-1 collapses the detailed gender identities presented in Table 4 into five broader categories including cisgender, meaning the respondent's gender identity matches their assigned sex at birth, transgender, nonbinary or agender, unreported, and prefer to self-disclose. This allows us to use categories with larger frequencies and more statistical power. These simple percentages again reinforce the point that transgender and nonbinary/agender students show higher rates of FI than cisgender students.

Table F-1: Frequencies and FI rates by gender identity

Gender Identity	Frequency	FI Rate (%)
Female	503	42.2
Cisgender Female	502	42.2
Trans Female	1	0
Male	199	29.7
Cisgender Male	198	29.3
Trans Male	1	100
Cisgender	720	39.3
Transgender[1]	7	87.5
Nonbinary or Agender	27	70.4
Unreported	50	36
Total	779	39.5

[1] Transgender is used here as an umbrella term to include trans men, trans women, and students who indicated "transgender" but did not report identifying as male or female. We include all respondents who indicated "transgender" in a gender identity question that allowed respondents to "Check all that apply."

To look closer at the significant and meaningful association between gender and FI, Table F-2 investigates how controlling for other variables that are associated with FI, such as first-generation status and SNAP receipt, impacts the relationship between gender and FI. Females and nonbinary students are demonstrably more vulnerable than their male counterparts. This relationship is not meaningfully changed when controlling for first-generation status, though the magnitude decreases. This indicates that female and nonbinary students are more likely to be first-generation college students, but this pattern does not explain away the gender disparities in FI. Likewise, controlling for SNAP receipt, a signal of recent and current economic status partially diminishes this significance and decreases the magnitude but gender as a covariate remains significant. Including all variables that were significant in univariate analysis makes the gender coefficients insignificant but provides limited explanatory power. The full model shows that after adjusting for all other variables, particularly after adjusting for "full-time status," being female is no longer significantly associated with FI. Nonbinary status remains significant in the full model; however, this finding warrants further exploration due to the small sample size of nonbinary respondents in this study.

Table F-2: Gender and FI

Variable	Gender	Controlling for First-Generation Status	Controlling for SNAP	Full Model

Gender (Male as referent)				
Female	1.76***	1.57**	1.40*	1.39
Nonbinary	5.11***	4.07***	3.46**	3.29**
Transgender (Cis as referent)	1.92	2.58	2.08	1.81
First-Generation College Student Status (Not first-generation as referent)				
First-Generation College Student		2.00***	1.84***	1.51**
SNAP Status (Not receiving SNAP as referent)				
History of SNAP			3.35***	2.75***
Currently on SNAP			1.77	1.60
Race/Ethnicity (White as referent)				
American Indian or Alaska Native				6.00*
Asian				1.49
Black				0.83
Latinx or Hispanic				1.43
Native Hawaiian or Pacific Islander (NHPI)				1.92
Multiracial / Two or more				1.87**
Class Standing (Frosh/Soph as referent)				
Jr/Senior+				0.77
Masters				0.45**
Doctorate				0.28
College				0.88***
Credit Hours (Part-time as referent)				
Full-time				1.20
Funding (No reported funding as referent)				

Reported Pell Grant	1.44*
Reported Work-Study	0.58
Living arrangement (Does not live with spouse/partner as referent)	
Lives with spouse/partner	0.65**
Living location (Does not live in OR, US as referent)	
Lives in Oregon	3.42**
Lives in the U.S.	1.00
Age	0.78*
Employment (Not employed as referent)	
Employed	0.81
Constant	0.44
N	675

Appendix G: Food Insecurity Prevalence by Living Location

Table 2 shows that Ecampus students living in Oregon have higher FI rates than other Ecampus students. In Table 3 when we included SNAP and gender, among other variables, the "Oregon effect" diminished. We explore this topic again here to explore which variables may best explore this unique vulnerability among Oregon residents enrolled with Ecampus. Controlling for class standing, college, race, and first-generation status show negligible explanatory power, with the coefficient for living in Oregon not changing appreciably. However, when controlling for SNAP receipt, the coefficient diminishes to nearly 1.0, indicating that the "Oregon" effect is eliminated. Further including the gender variables shows that these also are related to FI, but they do not impact the Oregon coefficient, nor are they obviously correlated with other variables in this model. The "Oregon" effect appears to be the result of higher levels of Ecampus enrollment among low-income Oregonians who have recently received SNAP.

Table G-1: Impact of Oregon Residency on FI

Variable	Lives in Oregon	Controlling for Class standing and College	Controlling for Race	Controlling for First-Generation Status	Controlling for SNAP receipt	Controlling for Gender
Lives in Oregon	1.3534*	1.47**	1.51**	1.44**	1.13	1.08
Class Standing (Frosh/Soph as referent)						
Jr/Senior+		0.62**	0.61**	0.64*	0.67	0.68
Graduate - Masters		0.25***	0.26***	0.28***	0.33***	0.33***
Graduate - PhD		0.19***	0.15***	0.17***	0.20**	0.14**
College		0.88***	0.87***	0.88***	0.88***	0.89***
Race (White as referent)						
Native American or Ala~n			4.22	4.33	4.22	5.06*
Asian			1.13	1.17	1.23	1.46
Black			0.91	0.85	0.96	1.17
Hispanic/Latino			1.55	1.40	1.38	1.49
Pacific Islander or Ha~n			0.85	0.82	1.06	1.43
Multiracial			2.28***	2.11***	2.00**	2.03**
First-Generation College Student Status (Not first-generation as referent)						
First Generation				1.65***	1.55***	1.47**
SNAP Status (Not receiving SNAP as referent)						
History of SNAP receipt					3.15***	3.21***
Currently on SNAP					1.69	1.55
Gender (Male as referent)						
Female						1.52**
Nonbinary						4.24***
Constant	0.5981***	1.76**	1.60*	1.15	0.98	0.66

N	741	713	709	703	700	683

The majority of Ecampus students live outside of Oregon, yet the highest number of responses for a single state came from those students living in Oregon (n=228). Responses were received from students representing 46 states across the U.S., with the highest number after Oregon from California (n=112) and Washington (n=67). The small number of results for many individual states makes the data more relevant when comparing by region.

Table G-2: FI rates among OSU Ecampus students by living location

Living Location	FI (%)	N
County		
Local (Benton, Linn, or Lane County)	47.7	65
Other Oregon counties	42.9	161
State		
Oregon	44.7	228
Other U.S. states	38.3	491
Region[1]		
West (including Oregon)	41.3	484
West (excluding Oregon)	38.3	256
Midwest	38.8	67
South	40.2	112
Northeast	33.9	56
Country		
U.S.	40.4	725
Outside the U.S.	21.1	19

[1] Regions were categorized based on U.S. Census regions

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