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## Prevalence of food insecurity and satisfaction with on-campus food choices among Australian university students

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### Abstract

*Purpose:* Food insecurity and poor access to healthy food is known to compromise tertiary studies in university students, and food choices are linked to student perceptions of the campus food environment. This study aims to describe the prevalence, demographic and education characteristics associated with food insecurity in a sample of Australian university students, and their satisfaction with on-campus food choices.

*Design/methodology/approach:* An online, cross-sectional survey conducted as part of the bi-annual sustainability themed survey was conducted at the University of Tasmania in March 2020. A single-item measure was used to assess food insecurity in addition to six demographic and education characteristics, and four questions about the availability of food, affordable food, sustainable food and local food on campus.

*Findings:* Survey data (n=1,858) were analysed using bivariate analyses and multivariate binary logistic regression. Thirty-eight percent of respondents (70% female; 80% domestic student; 42% aged 18-24 years) were food insecure. Overall, 41% of students were satisfied with the food available on campus. Nearly half (47%) of food insecure students were dissatisfied or very dissatisfied with the availability of affordable food on campus. A minority of students were satisfied with the availability of sustainable food (37%) and local food (33%) on campus.

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*Originality:* These findings demonstrate a high prevalence of food insecurity and deficits in the university food environment, which can inform the development of strategies to improve the food available on campus, including affordable, sustainable, and local options.

**Keywords:** food insecurity; food security; university students; college students, campus sustainable food, food environment

## 1. Introduction

Food security is considered a fundamental human right, and it exists when all people, at all times, have physical, social, and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life (FAO, 2002). Food insecurity may occur when these needs are not met, or when food cannot be accessed in socially acceptable ways (FAO, 2002). In Australia, the national prevalence of food insecurity is estimated to be around 4% (ABS, 2015). However, a comprehensive review of Australian research has indicated there are various populations at substantially higher risk (McKay *et al.*, 2019). Australian studies that include university students consistently demonstrate that this cohort has higher rates of food insecurity compared with the general population, with prevalence rates reported between 13% (Hughes *et al.*, 2011) and 26% (Gallegos *et al.*, 2014). However, university student prevalence rates can be inconsistent depending on the food insecurity tool applied (Hughes *et al.*, 2011), and prevalence rates of up to 48% have been documented using more comprehensive food security tools (Micevski, Thornton & Brockington *et al.*, 2014, Whatnall *et al.*, 2020). Internationally, the rates of university student food insecurity are approximately 42% (Bruening *et al.*, 2017). The experience of food insecurity can result in inadequate nutritional intakes (Hiller *et al.*, 2019) and worse overall health outcomes in university students (Payne-Sturges *et al.*, 2018, Patton-López *et al.*, 2014, Knol *et al.*, 2017). In relation to academic outcomes, food insecure students have poorer academic achievement (Hagedorn and Olfert, 2018) and are three times more likely to defer their tertiary studies (Gallegos *et al.*, 2014).

University students may be at higher risk of reduced access to nutritious food due to both physical and financial constraints (Martinez *et al.*, 2018). Given university students spend a substantial amount of time on campus, the campus food environment is thought to play an important role in influencing student food behaviours (Tam *et al.*, 2016). Despite this, a study of fifteen tertiary institutions concluded that current on-campus food environments provide

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3 only limited support for healthy eating (Horacek *et al.*, 2013). This is concerning, given that  
4 university students' food choices influence their current health status and that behaviours  
5 developed during early adulthood may be maintained over their lifetime. It has been reported  
6 that university students on-campus food purchasing habits are influenced by the perceived  
7 value, convenience, and cost of foods (Tam *et al.*, 2016), indicating that the availability and  
8 affordability of healthy food on campus are major factors in influencing dietary behaviours of  
9 university students. Additionally, in line with growing world-wide trends, university students'  
10 food buying decisions are also influenced by altruistic values related to sustainable practices  
11 (Tirelli *et al.*, 2013). Sustainable diets play a key role in maintaining nutritional well-being,  
12 and their consumption supports sustainable food production (Lawrence *et al.*, 2015), while also  
13 ensuring future food security (Berry *et al.*, 2015). As such, sustainability is being incorporated  
14 as a new long-term time dimension within the definition of food security, which encompasses  
15 the role of nutrition for a healthy life, for present and future generations (Berry *et al.*, 2015).  
16 Positively, some university food service providers have begun incorporating sustainability  
17 initiatives within their own food service operations, including the use of locally sourced  
18 products (Campbell *et al.*, 2014), which are favoured by consumers for their price and  
19 perceived quality. Additionally, there is growing interest, adoption and action on the United  
20 Nations (UN) Sustainable Development Goals (SDGs) (UN, 2015) within the university sector,  
21 including the identification of priority areas, opportunities and gaps related to the achievement  
22 of the SDGs (Sustainable Development Solutions Network Australia/Pacific, 2017).  
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38 As students' food choices are linked to their perceptions and experiences of the campus  
39 food environment (Alber *et al.*, 2018), campus food environments may either positively or  
40 negatively affect food insecurity. Further research is required to determine the relationship  
41 between perceptions of the campus food environment and levels of food insecurity in university  
42 students. Understanding the prevalence of food insecurity among university students, in  
43 addition to student perceptions and experience of the campus food environment, could inform  
44 the development of strategies to address issues with food on campus and alleviate food  
45 insecurity in this vulnerable group. Therefore, the aim of this study was to determine the  
46 prevalence of food insecurity and its relationship with the satisfaction of on-campus food  
47 choices among students at an Australian university.  
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## 2. Methods

### 2.1. Study setting and participants

The University of Tasmania (UTAS) is a public research university primarily located in Tasmania, Australia. UTAS has three main Tasmanian campuses (Hobart, Launceston and Cradle Coast), and a campus in the inner-city suburb of Rozelle in Sydney, New South Wales. The 2020 UTAS Student Sustainability Survey was the third biennial sustainability survey at UTAS and followed similar surveys of students and staff in 2016 and 2018. All UTAS students (n=31,143) were invited to participate by completing an online survey.

While objective mapping of the UTAS university food environments has not been performed, an internet search of the campus retail environment shows that each Tasmanian campus has multiple on-campus cafes and restaurants that offer hot and cold food and refreshments. Hobart campuses have nine outlets (one of which is for staff members only), Launceston has three, and Cradle Coast has two. Onsite cafes/restaurants are not present at the Sydney campus, but numerous off-campus food outlets are situated nearby. In addition to these options, each campus has vending machines in multiple locations which stock various snack foods and there are also a number of edible gardens, orchards and food allotments from which students can source fresh food. From a systems and governance perspective UTAS commenced using STARS (Sustainability Tracking, Assessment and Rating System) to monitor its sustainability performance within the food categories in 2019. UTAS is currently developing a food on campus strategy to promoting and supporting sustainable food systems.

### 2.2. Questionnaire Development

The primary purpose of the Student Sustainability Survey was to document perceptions of sustainability in students' personal lives and sustainability at UTAS. The survey was developed in response to the University's increasing commitment to the SDGs. For the first time, due to the importance of sustainability in food systems and nutrition (Grosso *et al.*, 2020), the survey was expanded to include five additional questions related to access to food and perceptions of the food available at the university campus.

Firstly, a single item survey question was included to identify the prevalence of food insecurity in the student population. The single-item measure of food insecurity asks: "In the last 12 months was there any time you have run out of food and not been able to purchase more?". Six response options included never, rarely, occasionally, often, very often and always. While not

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3 a comprehensive measure of food insecurity, the use of this screening question is justified in  
4 the context of this large survey and may be useful to inform the need for future, more focussed  
5 research. In addition, this has been the most widely applied question of food insecurity in the  
6 Australian population, allowing for wide comparison of the survey results (McKay *et al.*, 2019).  
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8 Four questions asked students about their satisfaction with the availability of food, affordable  
9 food, sustainable food, and Tasmanian-grown foods available on their campus. Responses were  
10 defined along a 11-point Likert scale from 11 (very satisfied) to 0 (very dissatisfied). The full  
11 survey included seven demographic and education questions including age, sex, level of study,  
12 university college, university campus, mode of study and enrolment type that are used in the  
13 analysis of the food-related questions.  
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### 21 *2.3. Data Collection*

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23 The 2020 UTAS Student Sustainability Survey was open to all students for two weeks during  
24 March 2020. Recruitment involved the promotion of the survey through internal emails,  
25 inclusion in newsletters, as well as promotion through the social media of various UTAS clubs,  
26 societies and interest groups. All participants were provided with a participant information  
27 sheet and by noting they were provided this information gave their informed consent for  
28 inclusion before participation. The study was conducted in accordance with the Declaration of  
29 Helsinki, and approval for this survey was granted by the Tasmanian Social Sciences Human  
30 Research Ethics Committee (H0015525). The survey was hosted using the online survey  
31 platform SurveyMonkey.  
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### 39 *2.4. Data analysis*

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41 Data were exported from the online survey platform and prepared for statistical analysis. All  
42 available survey data was used in the analyses. Data were analysed using IBM SPSS Statistics  
43 for Windows, Version 25.0 (IBM Corp. Armonk, NY). Responses to the single-item food  
44 insecurity question were recoded as either Yes or No to indicate two groups of food security: 1)  
45 food secure (students reporting 'never') and food insecure (students reporting 'rarely,  
46 occasionally, often, very often and always'). The variables of agreement for the questions about  
47 food satisfaction were recoded into 5 categories (from 11) for this analysis due to low numbers  
48 in some categories, for example 0, 1 and 2 were recoded into 1 (very dissatisfied); 3, 4 were  
49 recoded into 2 (dissatisfied); 5 (neither satisfied or dissatisfied) was recoded to 3; 6, 7 were  
50 recoded into 4 (satisfied); and 8, 9, 10 were recoded into 5 (very satisfied). The categories for  
51 some of the socio-demographic variables were collapsed due to low counts. Age was collapsed  
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3 from 7 categories to 5 due to low numbers in the oldest 3 age groups ('55 to 64', '65 to 74' and  
4 '75 or older' were grouped in '55 and over'). Individual campuses were collapsed into those in  
5 Hobart, Launceston, Cradle Coast, Sydney, Distance and Other.  
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9 All demographic and education variables were either categorical or ordinal and were cross-  
10 tabulated and summarised with frequencies and proportions. Cross-tabulations were employed  
11 to generate descriptive statistics related to food security status and with each of the socio-  
12 demographic variables. Univariate logistic regression was performed individually for each  
13 demographic and education variable to generate unadjusted odds ratios for food insecurity. A  
14 multivariable logistic regression was performed including all variables that were associated with  
15 food insecurity in the univariate analyses (any level of the variable had  $p < 0.1$ ) to yield adjusted  
16 odds ratios for food insecurity. Chi-square test with Cramer's V (effect size) was used to  
17 compare student satisfaction with the availability of food, affordable food, sustainable food,  
18 and Tasmanian grown food on campus by both demographic and education variables, and by  
19 food insecurity status. The significance level for all analyses was set at  $p \leq 0.05$  and Cohen's  
20  $d$  cut offs for the effect size were adopted (small ( $>0.2$ ), medium ( $>0.5$ ) and large ( $>0.8$ ) (Cohen,  
21 2013).  
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### 31 32 **3. Results**

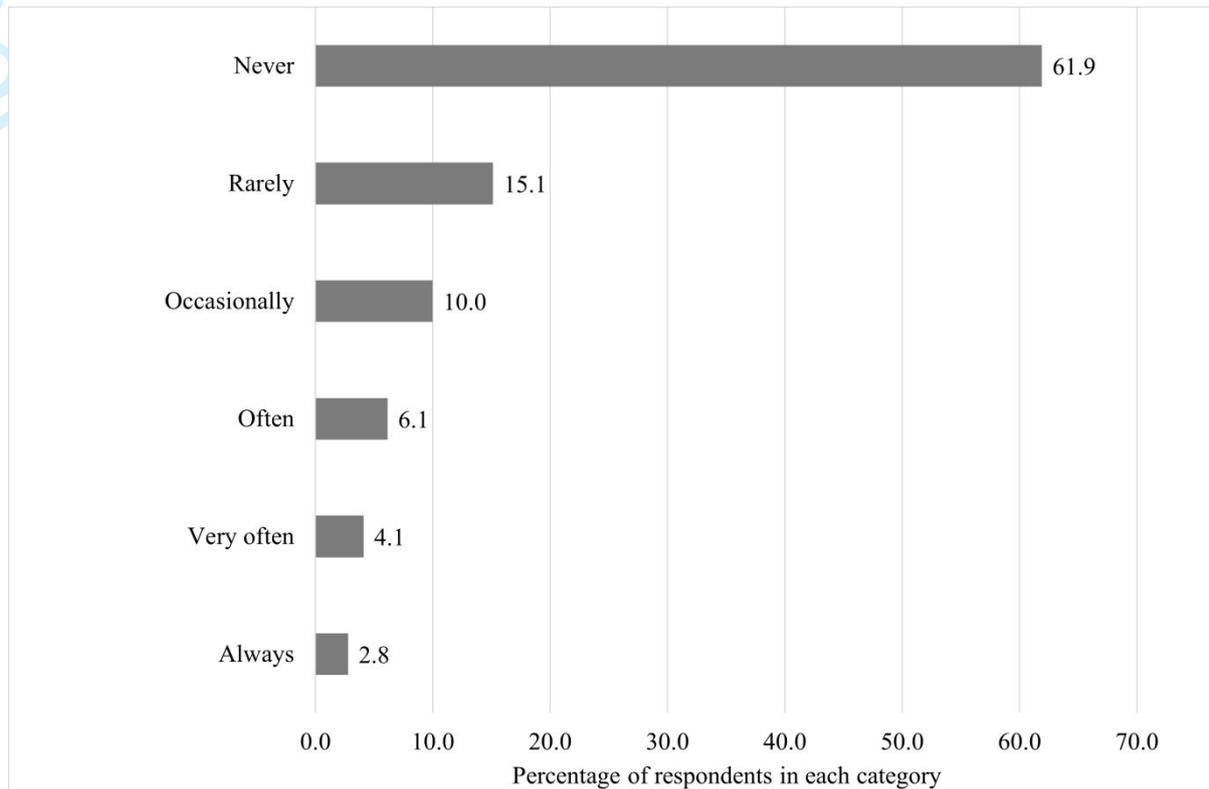
33  
34 In total, the survey received 1,858 responses, which is approximately 6% of the UTAS student  
35 cohort at the time of the survey ( $n=31,143$ ). Key demographic and education characteristics of  
36 the survey respondents according to food security status are presented in Table 1. A high  
37 proportion of respondents were aged between 18 and 24 years (42%) and were in their first  
38 year of study (37%). Respondents were predominantly on-campus students (65%), based at a  
39 Hobart campus (48%), and were domestic students (80%). A higher proportion of students aged  
40 18 – 24 years (39%) and 25-34 years (45%) reported being food insecure, in comparison to  
41 25% of students aged 55 years and over. A higher proportion of on-campus students (41%)  
42 reported being food insecure in comparison to distance students (32%), and a higher proportion  
43 of international students were food insecure (54%) in comparison to domestic students (34%).  
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**Table 1:** Food Security Status of the sample of University students according to demographic and education characteristics

		Food Insecure	Food Secure	Total
		n (%)		
Age (n=1510)	18 to 24	247 (39.0)	386 (61.0)	633 (41.9)
	25 to 34	179 (45.1)	218 (54.9)	397 (26.3)
	35 to 44	70 (36.5)	122 (63.5)	192 (12.7)
	45 to 54	40 (29.0)	98 (71.0)	138 (9.1)
	55 and over	38 (25.3)	112 (74.7)	150 (9.9)
Gender (n=1509)	Female	404 (38.1)	657 (61.9)	1061 (70.3)
	Male	159 (37.4)	266 (62.6)	425 (28.2)
	Other	3 (60.0)	2 (40.0)	5 (0.3)
	Undisclosed	9 (50.0)	9 (50.0)	18 (1.2)
Level of study (n=1505)	1st year	216 (38.7)	342 (61.3)	558 (37.1)
	2nd year	111 (41.0)	160 (59.0)	271 (18.0)
	3rd year	56 (37.6)	93 (62.4)	149 (9.9)
	4th year	38 (40.9)	55 (59.1)	93 (6.2)
	Postgraduate	154 (35.5)	280 (64.5)	434 (28.8)
Mode of study (n=1505)	Distance	158 (32.2)	333 (67.8)	491 (32.6)
	On campus	415 (40.9)	599 (59.1)	1014 (64.7)
Campus (n=1511)	Cradle Coast	18 (36.0)	32 (64.0)	50 (3.3)
	Hobart	289 (39.6)	441 (60.4)	730 (48.3)
	Launceston	114 (39.4)	175 (60.6)	289 (19.1)
	Online/ Distance	118 (32.0)	251 (68.0)	369 (24.4)
	Other	18 (47.4)	20 (52.6)	38 (2.5)
	Sydney	18 (51.4)	17 (48.6)	35 (2.3)
Enrolment status (n=1505)	Domestic student	414 (34.1)	799 (65.9)	1213 (80.4)
	International student	160 (54.1)	136 (45.9)	296 (19.6)

### 3.1. Prevalence of food insecurity and association with demographic and education characteristics

The prevalence of food insecurity among students is reported in Figure 1, demonstrating 15% of students reported running out of food rarely, 10% occasionally, and a further 13% reporting running out of food more frequently. When coded as a binary variable, these results indicate that 38.1% of students reported experiencing food insecurity in the past 12 months and 61.9 % (n=937) reported being food secure.



**Figure 1:** Prevalence of food insecurity, percentage of respondents in each category of food security. Data expressed as a %; n=1514.

The univariate analysis confirms these differences as statistically significantly different, where in comparison to students aged 55 years and over, all other students had higher odds of experiencing food insecurity. Additionally, on-campus students were 50% more likely to experience food insecurity and international students were more than two-fold more likely to report food insecurity than domestic students. After controlling for demographic and education characteristics found to be significant in bivariate analyses, age and enrolment status remained significantly associated with food security status (Table 2). In comparison with students aged 55 years and over, students aged 18 - 24 years were 60% more likely to be food insecure, and students aged 25 – 35 years were 85% more likely to be food secure. The increased odds of food insecurity remained for international students, with close to two-fold greater odds of being food insecure compared to domestic students. However, after controlling for other factors, there was no significant difference in the odds of food security between distance and on-campus students.

**Table 2.** Univariate and multivariate logistic regression results of food security with demographic and education characteristics in a sample of Australian university students

	Univariate			Multivariate			
	Odds Ratio	95% CI	p-Value	Adjusted Odds Ratio	95% CI	p-Value	
Age (n=1510)	18 to 24	1.886	1.263-2.817	0.002	1.653	1.059-2.580	0.027
	25 to 34	2.420	1.594-1.594	<0.0001	1.850	1.176-2.912	0.008
	35 to 44	1.691	1.056-1.056	0.029	1.520	0.940-2.460	0.088
	45 to 54	1.203	0.715-2.024	0.486	1.207	0.714-2.039	0.482
	55 and over (ref)	-	-	-	-	-	-
Gender (n=1509)	Female (ref)	-	-	-	-	-	-
	Male	0.972	0.771-1.226	.811	-	-	-
	Other	2.439	0.406-14.661	.330	-	-	-
	Prefer not to specify	1.626	0.640-4.131	.307	-	-	-
Level of study (n=1505)	1st year (ref)	-	-	-	-	-	-
	2nd year	1.098	0.817-1.477	0.534	-	-	-
	3rd year	0.953	0.657-1.384	0.802	-	-	-
	4th year	1.094	0.700-1.711	0.694	-	-	-
	Postgraduate	0.871	0.671- 1.130	0.297	-	-	-
Mode of study (n=1505)	Distance (ref)	-	-	-	-	-	-
	On campus	1.460	1.164-1.832	0.001	1.026	0.774-1.359	0.858
Campus (n=1511)	Cradle Coast (ref)	-	-	-	-	-	-
	Hobart	1.165	0.642-2.115	0.616	-	-	-
	Launceston	1.158	0.621-2.161	0.645	-	-	-
	Online/ Distance	0.836	0.451- 1.550	0.569	-	-	-
	Other	1.600	0.677-3.780	0.284	-	-	-
Enrolment status (n=1505)	Sydney	1.882	0.781-4.534	0.158	-	-	-
	Domestic student (ref)	-	-	-	-	-	-
	International student	2.271	1.755-2.938	<0.0001	1.997	1.503-2.653	<0.0001

### 3.2. Student satisfaction with the availability of food on campus

Overall, 41% of students were satisfied with the food available on campus. A chi-square test indicated that students of different ages reported different levels of satisfaction with the availability of food on campus ( $\chi^2$  (16, n=1245) = 60.602,  $p < 0.001$ ,  $V = 0.110$ ). Only 6% of students aged 55 years and over reported being very satisfied, in comparison to the 18% of students aged 18-24 year. Student level of study reported significantly different levels of satisfaction with food available on campus ( $\chi^2$  (16, n=1241) = 46.703,  $p < 0.001$ ,  $V = 0.097$ ), with 10% of postgraduate students very satisfied with the food available on campus compared with 20% of first year students. Domestic students (17.3%) were more likely to be very dissatisfied with the food available on campus in comparison to international students (12.8%) ( $\chi^2$  (4, n=1243) = 18.082,  $p = 0.001$ ,  $V = 0.121$ ). There were no differences in satisfaction reported between genders ( $p > 0.05$ ), or between food secure and food insecure students (Table 3). As this relates to food provided on campus, the differences between on-campus or distance students was not investigated.

**Table 3:** Student satisfaction with the availability of food, affordable food, sustainable food, and locally-grown foods available on their campus according to Food Security Status

		Very dissatisfied	Dissatisfied	Neither satisfied nor dissatisfied	Satisfied	Very satisfied	$\chi^2$	p value	Cramer's V
Satisfaction with food available on campus (n=1248)	Food Insecure	88 (17.9)	74 (15.0)	127 (25.8)	126 (25.6)	77 (15.7)	6.664	0.155	0.073
	Food Secure	116 (15.3)	94 (12.4)	240 (31.7)	198 (26.2)	108 (14.3)			
	Total	204 (16.3)	168 (13.5)	367 (29.4)	324 (26.0)	185 (14.8)			
Satisfaction with affordable food options on campus (n=1023)	Food Insecure	105 (25.2)	92 (22.1)	90 (21.6)	74 (17.8)	55 (13.2)	9.514	<b>0.049</b>	<b>0.096</b>
	Food Secure	136 (22.4)	98 (16.1)	161 (26.5)	129 (21.3)	83 (13.7)			
	Total	241 (23.6)	190 (18.6)	251 (24.5)	203 (19.8)	138 (13.5)			
Satisfaction with sustainable food options on campus (n=1235)	Food Insecure	84 (17.1)	88 (18.0)	121 (24.7)	124 (25.3)	73 (14.9)	17.626	<b>0.001</b>	<b>0.119</b>
	Food Secure	141 (18.9)	92 (12.3)	252 (33.8)	157 (21.1)	103 (13.8)			
	Total	225 (18.2)	180 (14.6)	373 (30.2)	281 (22.8)	176 (14.3)			
Satisfaction with locally-grown food options on campus (n=1207)	Food Insecure	92 (19.2)	88 (18.4)	129 (26.9)	101 (21.1)	69 (14.4)	6.341	0.175	0.072
	Food Secure	147 (20.2)	112 (15.4)	238 (32.7)	143 (19.6)	88 (12.1)			
	Total	239 (19.8)	200 (16.6)	367 (30.4)	244 (20.2)	158 (13.0)			

Data expressed as n(%),  $\chi^2$ , p-value and Cramer's V derived from Chi-square test.

### 3.3. Student satisfaction with affordable food options on campus

Nearly a third of students (31%) were satisfied with the availability of affordable food options on campus, and a further 18% reported being dissatisfied and 22% reported being very dissatisfied. There were no significant differences in the reported satisfaction of the availability of affordable food across age groups, between genders, between colleges or campuses or between domestic or international students (all  $p > 0.05$ ). However, a significant difference was evident in the reported satisfaction with affordable food on campus with nearly half (47%) of food insecure students dissatisfied or very dissatisfied in comparison to 38% of food secure student (Table 3), with a small effect size.

### 3.4. Student satisfaction with sustainable food options on campus

The highest proportion of respondents (30%) were neither satisfied nor dissatisfied with the sustainable food options on campus, and a further 37% reported being either satisfied or very satisfied with the food available on campus. Fewer students aged 55 years and over reported being satisfied with the availability of sustainable food on campus than students aged 18-24 years, with 11% vs 16% reporting being 'very satisfied' respectively ( $\chi^2 (16, n=1232) = 40.561, p = 0.001, V = 0.091$ ). Males reported being more satisfied than females ( $\chi^2 (12, n=1232) = 40.561, p = 0.024, V = 0.080$ ). Students at different levels of study reported significantly different levels of satisfaction with the sustainable food available on campus ( $\chi^2 (16, n=1228) = 59.699, p < 0.001, V = 0.110$ ), with 11% of postgraduate students very satisfied with the sustainable food available on campus compared with 20% of first year students. Domestic students (20%) were more likely to be very dissatisfied with the food available on campus in comparison to international students (11%) ( $\chi^2 (4, n=1230) = 25.735, p < 0.001, V = 0.145$ ). A higher proportion of food insecure students (40%) reported being satisfied or very satisfied with the availability of sustainable food on campus in comparison to 35% of food secure students (Table 3).

### 3.5. Student satisfaction with locally grown food options on campus

A slightly higher proportion of students reported being dissatisfied or very dissatisfied (36%) with the locally grown food available on campus, in comparison to 33% who reported being satisfied or very satisfied. A chi-square test indicated that students of different ages reported different levels of satisfaction with the locally grown food available on campus ( $\chi^2 (16, n=1204) = 39.789, p = 0.001, V = 0.091$ ) with only 6% of students aged 55 years and over reported

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3 being very satisfied with the locally grown food available on campus, in comparison to the 14%  
4 of students aged 18-24 years. There was a difference between genders ( $\chi^2$  (12, n=1203) =  
5 24.941,  $p = 0.015$ ,  $V = 0.083$ ) with males more likely to be satisfied (25% vs 18%) or very  
6 satisfied (16% vs 12%) with the locally grown food available on campus. Student level of study  
7 reported significantly different levels of satisfaction with the food available on campus ( $\chi^2$  (16,  
8 n=1200) = 71.304,  $p < 0.001$ ,  $V = 0.122$ ), with 5% of both 3rd and 4th year students very  
9 satisfied with the locally grown food available on campus compared with 17% of 1st year  
10 students. Domestic students (23%) were more likely to be very dissatisfied with the locally  
11 grown food available on campus in comparison to international students (9%) ( $\chi^2$  (4, n=1202)  
12 = 76.421,  $p < 0.001$ ,  $V = 0.252$ ). There was no difference between food secure and food  
13 insecure students.  
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#### 25 **4. Discussion**

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27 This study presents results from a cross-sectional survey to determine the prevalence of  
28 food insecurity and perceptions of the campus food environment in a sample of university  
29 students in Tasmania, Australia. Our results demonstrate that 38% of students reported  
30 experiencing food insecurity in the past 12 months. Concerningly, 13% of respondents reported  
31 running out of food often to always, indicating more severe food insecurity. While significantly  
32 higher than the national Australian prevalence of food insecurity in the general population (4%)  
33 (ABS, 2015), these statistics are lower than in recent analyses of Australian university students  
34 at other tertiary institutions. For example, in a smaller study at a different Australian institution  
35 (Whatnall *et al.*, 2020), nearly half of university students (48%) were reported to be food  
36 insecure. The higher proportion of food insecure respondents in their study may be attributed  
37 to the more comprehensive food insecurity assessment tool applied, which has shown to be a  
38 more sensitive measure of food insecurity (McKay *et al.*, 2019). Despite the single-item food  
39 insecurity assessment tool that was used in our study being the most common method applied  
40 in Australian research (McKay *et al.*, 2019), it has been suggested that this tool may  
41 underestimate food insecurity (McKechnie *et al.*, 2018).  
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54 In our analysis, the demographic characteristics independently associated with food  
55 insecurity were international students and students who were younger than 35 years of age.  
56 Interestingly, being an international student has not been significantly associated with food  
57 insecurity in other Australian studies of university students (Whatnall *et al.*, 2020, Hughes *et*  
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3 *al.*, 2011, Gallegos *et al.*, 2014), indicating this may be unique to international Tasmanian  
4 university students. Additionally, younger age has only been associated with food insecurity in  
5 one Australian study (Hughes *et al.*, 2011). However, low household income and living out of  
6 home have been consistently identified as major factors implicated in food insecurity (Hughes  
7 *et al.*, 2011, Whatnall *et al.*, 2020, Gallegos *et al.*, 2014), which were factors not collected in  
8 our survey. Of particular note is that our survey was conducted prior to the beginning of the  
9 COVID-19 pandemic in Australia, and therefore these results may underestimate the  
10 prevalence of food insecurity during the pandemic, given that younger adults in casual and  
11 part-time work have been disproportionately affected (STATCAN, 2020). The COVID-19  
12 pandemic has also shown to have exacerbated food insecurity in Australia, especially in  
13 younger people and temporary residents (Kent *et al.*, 2020). This may be related to the issue  
14 that international students and other temporary residents in Australia have been ineligible for  
15 government financial support throughout the pandemic. Given the high proportion of food  
16 insecure students in our study using a tool which may under-estimate the prevalence, and the  
17 relatively unique demographic and education characteristics determined in our sample, further  
18 research in the Tasmanian tertiary context is warranted using more comprehensive food  
19 security tools, and including other relevant socio-demographic factors. Despite this, our study  
20 provides preliminary evidence that is of sufficient quality to strongly advocate for universities  
21 to address the issue of food insecurity for their students. To some extent, and especially in  
22 response to the COVID-19 pandemic, Australian universities are already engaged with  
23 providing emergency food relief and other temporary measures to support students. However,  
24 given the increasing inclusion of the SDGs in guiding many Australian universities activities,  
25 a transition to longer-term solutions which address the inequalities in fundamental human  
26 rights experienced by university students, such as poverty and housing stress, are required. In  
27 addition, universities have a greater level of control regarding the creation of supportive food  
28 environments on campus and therefore, should implement strategies which advocate for  
29 equitable access to sufficient, healthy food for all their students, regardless of their  
30 demographic and education characteristics.

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University food environments can have an important influence on when, where, and what  
students eat (Story *et al.*, 2008). As most Australian students purchase food on campus (Tam  
*et al.*, 2016), there are opportunities for universities to intervene in order to improve diet quality  
and reduce food insecurity in this already vulnerable group. In our study, a greater proportion  
of students were satisfied rather than dissatisfied with the food available on campus. This is a

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3 positive finding as universities have a responsibility to meet the needs of their students, and if  
4 students' needs related to food are not met on campus, students may travel off campus to other  
5 outlets, including fast food restaurants which have a high proportion of unhealthy options.  
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7 Despite this positive finding, our study found that close to half (47%) of food insecure students  
8 were dissatisfied with the availability of affordable food options on campus, which was  
9 significantly higher than students who were food secure. Student food purchasing behaviours  
10 have been shown to be heavily influenced by financial factors (Klassen *et al.*, 2005), and  
11 Australian research has reported that the price of food on campus was the main reason for  
12 buying food elsewhere (71%) (Tam *et al.*, 2016). In that study, the majority of university  
13 students (55%) thought the food options on campus provided poor value for money and 90%  
14 of students suggested that discounts on healthy choices would support them to purchase and  
15 consume these foods (Tam *et al.*, 2016). Therefore, providing affordable, and healthy food  
16 options should remain a priority for campus food service providers, as price has consistently  
17 been shown to be a major determinant of student satisfaction with campus food services (El-  
18 Said and Fathy, 2015). Student-led suggestions for improvements to the campus food  
19 environment have included both lowering the cost and increasing the variety of food choices  
20 available, so while there is a demand for healthy food options on campus, it appears that price  
21 may be the most important factor to support change.  
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35 As Australian universities increase their commitment to sustainable practices  
36 (Sustainable Development Solutions Network Australia/Pacific, 2017), and become  
37 increasingly aware of their role to support food production which minimises environmental  
38 impact, sustainable food choices on campus should be supported to improve. In our study, only  
39 a minority of students reported being satisfied with the availability of sustainable food options  
40 (37%) and a further 30% reported a neutral response. These results indicate that many students  
41 are dissatisfied with the types of sustainable and locally grown foods offered, and a significant  
42 proportion may be unaware of the availability of these food options or the provenance of foods  
43 available on campus. Whether these details were unclear at points of sale or the options did not  
44 meet the preferences of students requires further investigation. Previous research has suggested  
45 that Australian consumers have mixed views on what constitutes sustainable foods (Mann *et*  
46 *al.*, 2018), which may further complicate the interpretation of our findings. Sustainable food  
47 was defined for the purposes of this study as food that is healthy and produced in a humane,  
48 environmentally-friendly, socially responsible and economically fair way. Improving the  
49 availability and accessibility of sustainable and locally grown food choices will have positive  
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3 impacts in the shorter and longer-term as sustainable diets contribute to food and nutritional  
4 security (White, 2020, Grosso *et al.*, 2020). Importantly, the production of sustainable, locally  
5 grown foods is key to providing long-term food security for communities (Kaiser, 2011).  
6 Promotion of sustainable food options on campus could align with promoting environmental  
7 awareness and moral obligations to influence consumer purchasing habits (Joshi and Rahman,  
8 2015). Conversely, previous Australian research has indicated that regardless of sustainable  
9 food options available, a large proportion (75%) of university students would purchase healthy  
10 or sustainable food selections if they were combined with meal deals and/or rewards systems  
11 (Tam *et al.*, 2016). In other settings, subsidies for healthy food have been related to positive  
12 nutrition behaviours in young adults (Roy *et al.*, 2015). Despite studies reporting positive views  
13 on sustainable diets, including for university students, consumers studies have shown that  
14 individuals tend to have limited knowledge about sustainable eating patterns, and may be  
15 largely unaware of the environmental impact of food-related behaviours (Mann *et al.*, 2018).  
16 Interestingly, consumers may be more motivated to adopt sustainable dietary changes if they  
17 are associated with additional benefits, such as supporting the local community (Mann *et al.*,  
18 2018). In our study, students reported lower levels of satisfaction with the availability of locally  
19 grown food (33%) options on campus. Previous American research in the university food  
20 campus environment have promoted the benefits and attributes of locally grown food, which  
21 included taste, freshness, support for the local economy, and minimized environmental impact,  
22 and this resulted in a higher willingness to pay for locally grown food options at on-campus  
23 food outlets (Campbell *et al.*, 2014). Therefore, implementing specific strategies to improve  
24 food and beverage labelling, including who is supplying the food and where it comes from may  
25 work to improve campus food environments and support food environments for students in  
26 Australia.

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29 Our study has a number of strengths, which include a relatively large sample size that  
30 is considerably larger than other Australian studies of food insecurity in university students.  
31 Additionally, by coupling an investigation of food insecurity with perceptions of the campus  
32 food environment, this study provides an opportunity to inform strategic and responsive actions  
33 which are within the realm of possibilities for universities to enact. Despite this, our results  
34 must be considered within the limitations of the study. Our study was a cross-sectional survey  
35 and therefore the results are descriptive, and inferences are limited by the design of the study.  
36 The survey was also unable to determine the food purchasing patterns of the students while on  
37 campus, which outlets they frequented, or the types of food on offer at each outlet, and these  
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will be important considerations for future work. Additionally, despite our large sample size and the university wide recruitment methods, our sample may not be representative of the wider UTAS student population, or university students more broadly in Australia, in particular as our survey had a higher proportion of female respondents which was greater than for domestic enrolments for females in Australia (Larkins, 2018). As this survey was a sustainability themed survey, the results may be biased towards representing those respondents who are more motivated to buy and consume sustainable foods. The survey tool also employed the single item question for food insecurity, which has been shown to underestimate the prevalence of food insecurity (McKechnie *et al.*, 2018). If the prevalence of food insecurity has been underestimated in our study, there is a clear need for more comprehensive and ongoing research in this student population. Lastly, future studies should also include more comprehensive demographic, housing and income-related questions to allow exploration of the sociodemographic predictors and consequences of food insecurity.

### *Conclusions and Next Steps*

In conclusion, our findings demonstrate a high prevalence of food insecurity in Australian university students and that it disproportionately affects international students and those younger than 35 years of age. Overall, less than half of students perceived the food available on campus favourably and nearly half of food insecure students were dissatisfied with the availability of affordable food on campus. Together, these findings indicate that at a university level and more broadly, the burden of food insecurity for students must be addressed to improve the health and academic outcomes of students, and improvements to the on-campus food environment should be considered. Our results point to practical strategies to improve the food available on campus, including increasing affordable, sustainable, and local options that meet the needs of both food secure and insecure students. Additionally, ongoing monitoring of food insecurity in university students using comprehensive tools and in representative populations remains a priority. Universities should also begin to address issues with the food available on campus through supporting the provision of sustainable, local and healthy food options, coupled with price decreases for healthy options to alleviate food insecurity in this vulnerable group. An important first step would include mapping and a thorough audit of the campus food environment and how students are exposed to, and interact with, food outlets on campus to identify deficits related to healthy, affordable, and sustainable foods. Additional qualitative exploration through student led focus groups would also contribute valuable insights about the

experience of food insecurity and the appropriateness of potential initiatives to improve students access to affordable and sustainable foods on campus.

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## **Bio-notes**

### **Ms Sandra Murray**

Sandra has worked at the University of Tasmania (UTAS) since 2005 teaching healthy and sustainable food systems, nutrition and public health within the School of Health Science. Sandra has been an accredited practicing dietitian for over 25 years and is a member of the Dietitians Association of Australia Food and Environment Interest Group. She is undertaking doctoral studies exploring food justice in Tasmania. Sandra is a co-facilitator of the University's Sustainable Food Systems Working Groups. Sandra was winner of the Australasian Campuses Towards Sustainability (ACTS) Green Gowns Award of Excellence 2020 for championing sustainable food systems initiatives within UTAS and external community stakeholders.

### **Mr Corey Peterson**

Corey has worked at the University of Tasmania since 2009 managing the Sustainability team and is charged with advancing a holistic organisational sustainability agenda. He served on the University of Tasmania governing Council from 2012-2020 and is the current President of Australasian Campuses Towards Sustainability (ACTS). He has also served on the Board of several community organisations, including Sustainable Living Tasmania for ten years (five as President), is a graduate of the Tasmanian Leaders Program and has joint master's degrees in environmental science and public administration. He also spent 16 years supporting science in Antarctica before immigrating to Tasmania.

### **Dr Carmen Primo Perez**

Carmen has been a sustainability professional at the University of Tasmania for nine years and is interested in all sustainability matters. She has a special passion for climate change issues and education for sustainability, partly because of her background as an academic in environmental sciences, discipline in which she worked as a lecturer and researcher for ten years in both Spain and Australia. Carmen is responsible for the University's Sustainability Tracking Assessment and Rating System (STARS) report, which includes food on campus and students' wellbeing, and she is committed to help the University advance in these and other sustainability-related areas. Carmen is also an Executive Board member of Australasian Campuses Towards Sustainability (ACTS)

### **Dr Catherine Elliott**

Catherine has been a sustainability professional at the University of Tasmania for three years. She is responsible for coordinating the University's Green Impact Program Coordinator and the award-winning Sustainability Integration Program for Students (SIPs).

### **Professor Margaret Otlowski**

Margaret is Professor of Law at the University of Tasmania, specialising in health law and ethics. From 2018-2020 she served as Chair of the University of Tasmania's Sustainability Committee and was also Chair of the University's Equity Committee in her capacity as Pro Vice-Chancellor (Culture, Wellbeing and Sustainability).

### **Mr Stuart Auckland**

Stuart is the Coordinator of the Community Health Development Program Area at the Centre for Rural Health (CRH) In Tasmania. Stuart has extensive experience in rural community

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2  
3 health development as both a practitioner and academic. Stuart's current research interests  
4 relate to better understanding the socio-cultural and environmental factors affect the potential  
5 for rural and remote communities to improve their health outcomes and reduce disparities. His  
6 current research interests lie in population health, in particular mental health, the social  
7 determinants of health and food security. He also has a strong interest in gaining an  
8 understanding of the dynamic constructs of rural communities that help build resilience.  
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### 10 **Dr Katherine Kent**

11  
12 Katherine is a public health nutritionist and postdoctoral research fellow who investigates  
13 food systems, dietary patterns and food insecurity in rural and regional populations of  
14 Australia. Katherine additionally conducts clinical research into dietary strategies that  
15 manage cognitive decline and cardiovascular health, with a focus on flavonoid-rich fruits and  
16 vegetables.  
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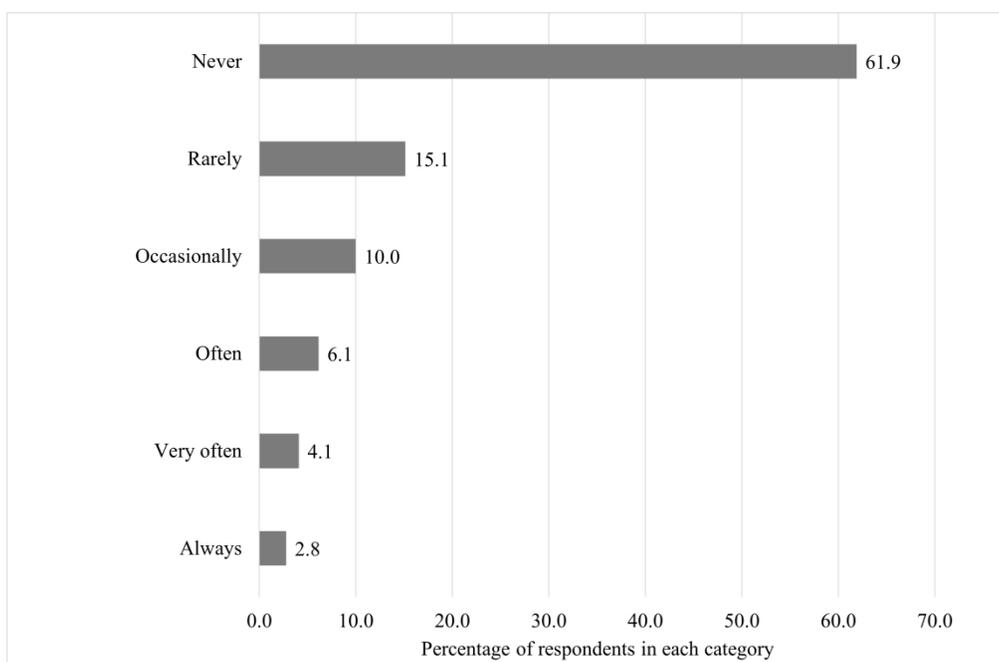


Figure 1 Prevalence of food insecurity, percentage of respondents in each category of food security. Data expressed as a %; n=1514.

**Table 1** Food Security Status of the sample of University students according to demographic and education characteristics

		Food Insecure	Food Secure	Total
		n (%)		
Age (n=1510)	18 to 24	247 (39.0)	386 (61.0)	633 (41.9)
	25 to 34	179 (45.1)	218 (54.9)	397 (26.3)
	35 to 44	70 (36.5)	122 (63.5)	192 (12.7)
	45 to 54	40 (29.0)	98 (71.0)	138 (9.1)
	55 and over	38 (25.3)	112 (74.7)	150 (9.9)
Gender (n=1509)	Female	404 (38.1)	657 (61.9)	1061 (70.3)
	Male	159 (37.4)	266 (62.6)	425 (28.2)
	Other	3 (60.0)	2 (40.0)	5 (0.3)
	Undisclosed	9 (50.0)	9 (50.0)	18 (1.2)
Level of study (n=1505)	1st year	216 (38.7)	342 (61.3)	558 (37.1)
	2nd year	111 (41.0)	160 (59.0)	271 (18.0)
	3rd year	56 (37.6)	93 (62.4)	149 (9.9)
	4th year	38 (40.9)	55 (59.1)	93 (6.2)
	Postgraduate	154 (35.5)	280 (64.5)	434 (28.8)
Mode of study (n=1505)	Distance	158 (32.2)	333 (67.8)	491 (32.6)
	On campus	415 (40.9)	599 (59.1)	1014 (64.7)
Campus (n=1511)	Cradle Coast	18 (36.0)	32 (64.0)	50 (3.3)
	Hobart	289 (39.6)	441 (60.4)	730 (48.3)
	Launceston	114 (39.4)	175 (60.6)	289 (19.1)
	Online/ Distance	118 (32.0)	251 (68.0)	369 (24.4)
	Other	18 (47.4)	20 (52.6)	38 (2.5)
	Sydney	18 (51.4)	17 (48.6)	35 (2.3)
Enrolment status (n=1505)	Domestic student	414 (34.1)	799 (65.9)	1213 (80.4)
	International student	160 (54.1)	136 (45.9)	296 (19.6)

**Table 2.** Univariate and multivariate logistic regression results of food security with demographic and education characteristics in a sample of Australian university students

	Univariate			Multivariate			
	Odds Ratio	95% CI	p-Value	Adjusted Odds Ratio	95% CI	p-Value	
Age (n=1510)	18 to 24	1.886	1.263-2.817	0.002	1.653	1.059-2.580	0.027
	25 to 34	2.420	1.594-1.594	<0.0001	1.850	1.176-2.912	0.008
	35 to 44	1.691	1.056-1.056	0.029	1.520	0.940-2.460	0.088
	45 to 54	1.203	0.715-2.024	0.486	1.207	0.714-2.039	0.482
	55 and over (ref)	-	-	-	-	-	-
Gender (n=1509)	Female (ref)	-	-	-	-	-	-
	Male	0.972	0.771-1.226	.811	-	-	-
	Other	2.439	0.406-14.661	.330	-	-	-
	Prefer not to specify	1.626	0.640-4.131	.307	-	-	-
Level of study (n=1505)	1st year (ref)	-	-	-	-	-	-
	2nd year	1.098	0.817-1.477	0.534	-	-	-
	3rd year	0.953	0.657-1.384	0.802	-	-	-
	4th year	1.094	0.700-1.711	0.694	-	-	-
	Postgraduate	0.871	0.671- 1.130	0.297	-	-	-
Mode of study (n=1505)	Distance (ref)	-	-	-	-	-	-
	On campus	1.460	1.164-1.832	0.001	1.026	0.774-1.359	0.858
Campus (n=1511)	Cradle Coast (ref)	-	-	-	-	-	-
	Hobart	1.165	0.642-2.115	0.616	-	-	-
	Launceston	1.158	0.621-2.161	0.645	-	-	-
	Online/ Distance	0.836	0.451- 1.550	0.569	-	-	-
	Other	1.600	0.677-3.780	0.284	-	-	-
	Sydney	1.882	0.781-4.534	0.158	-	-	-
Enrolment status (n=1505)	Domestic student (ref)	-	-	-	-	-	-
	International student	2.271	1.755-2.938	<0.0001	1.997	1.503-2.653	<0.0001

**Table 3** Student satisfaction with the availability of food, affordable food, sustainable food, and locally-grown foods available on their campus according to Food Security Status

		Very dissatisfied	Dissatisfied	Neither satisfied nor dissatisfied	Satisfied	Very satisfied	$\chi^2$	p value	Cramer's V
Satisfaction with food available on campus (n=1248)	Food Insecure	88 (17.9)	74 (15.0)	127 (25.8)	126 (25.6)	77 (15.7)	6.664	0.155	0.073
	Food Secure	116 (15.3)	94 (12.4)	240 (31.7)	198 (26.2)	108 (14.3)			
	Total	204 (16.3)	168 (13.5)	367 (29.4)	324 (26.0)	185 (14.8)			
Satisfaction with affordable food options on campus (n=1023)	Food Insecure	105 (25.2)	92 (22.1)	90 (21.6)	74 (17.8)	55 (13.2)	9.514	<b>0.049</b>	<b>0.096</b>
	Food Secure	136 (22.4)	98 (16.1)	161 (26.5)	129 (21.3)	83 (13.7)			
	Total	241 (23.6)	190 (18.6)	251 (24.5)	203 (19.8)	138 (13.5)			
Satisfaction with sustainable food options on campus (n=1235)	Food Insecure	84 (17.1)	88 (18.0)	121 (24.7)	124 (25.3)	73 (14.9)	17.626	<b>0.001</b>	<b>0.119</b>
	Food Secure	141 (18.9)	92 (12.3)	252 (33.8)	157 (21.1)	103 (13.8)			
	Total	225 (18.2)	180 (14.6)	373 (30.2)	281 (22.8)	176 (14.3)			
Satisfaction with locally-grown food options on campus (n=1207)	Food Insecure	92 (19.2)	88 (18.4)	129 (26.9)	101 (21.1)	69 (14.4)	6.341	0.175	0.072
	Food Secure	147 (20.2)	112 (15.4)	238 (32.7)	143 (19.6)	88 (12.1)			
	Total	239 (19.8)	200 (16.6)	367 (30.4)	244 (20.2)	158 (13.0)			

*Data expressed as n(%),  $\chi^2$ , p-value and Cramer's V derived from Chi-square tests*

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