

**FOOD SECURITY STATUS AMONG COLLEGE STUDENTS
AT THE UNIVERSITY OF HAWAI'I AT MĀNOA**

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ABSTRACT

This study was conducted to investigate food insecurity among college students at the University of Hawai'i at Mānoa (UHM). Objectives of the study were to determine the prevalence of food insecurity and the predictors and consequences of food insecurity among UHM students. A survey was conducted among non-freshmen, classified students from randomly selected classes. The survey included questions on food security, demographic determinants, spending patterns, dietary data, lifestyle characteristics, and health determinants.

Twenty one percent of the students surveyed were food insecure, while 24% were marginally food secure or at risk of food insecurity. Results show that the sociodemographic factors contributing to food insecurity among UHM students include living on campus, living off-campus with roommates, being Native Hawaiian and Pacific Islander, Filipino, and mixed (two or more ethnicities), and being new in Hawai'i. Only the amount of money spent on eating out and on total food, combining groceries and eating out expenditures, was statistically significantly different between the food secure and the insecure. Food insecurity among UHM students seemed to be affecting their dietary intake, as well as their perceived health status and energy level.

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LIST OF ABBREVIATIONS

BMI	Body Mass Index
CCHIP	Community Childhood Hunger Identification Project
CNSTAT	Committee on National Statistics of the National Academies
CPS	Current Population Survey
CSFII	Continuing Survey of Food Intakes by Individuals
ECLS	Early Childhood Longitudinal Study
EFNEP	Expanded Food and Nutrition Education Program
FNS	Food and Nutrition Service
FRAC	Food Research and Action Center
FSP	Food Stamp Program
FSS	Food Security Supplement
HEI	Healthy Eating Index
HFSSM	Household Food Security Survey Module
HHS	Hawaii Health Survey
NCHA	National College Health Assessment
NHANES	National Health and Nutrition Examination Survey
SIPP	Survey of Income and Program Participation
UHM	University of Hawaii at Manoa
USDA	U.S. Department of Agriculture

WIC

**Special Supplemental Program for Women, Infant, and
Children**

CHAPTER 1

LITERATURE REVIEW

Food security has been defined as “the access by all people at all times to enough food for an active, healthy life. It includes at a minimum the ready availability of nutritionally adequate and safe foods, and the assured ability to acquire acceptable foods in socially acceptable ways (e.g., without resorting to emergency food supplies, scavenging, stealing, or other coping strategies).”(1) Food insecurity, on the other hand, “exists when there is limited or uncertain availability of nutritionally adequate and safe foods or limited or uncertain ability to acquire acceptable foods in socially acceptable ways.” (1) Food insecurity, under this definition, is a condition resulting from financial resource constraints (2).

Although households with incomes below the 135% poverty level have higher rates of food insecurity than the national average (3), there are factors other than income that could affect household food security status (2). Such factors include an unexpected job loss by the head of the household, geographical differences in the cost of food and other necessities, such as housing (2) and lack of skills in managing money and food (e.g., preparing budgets, managing bills, and stretching groceries at the end of the month) (4).

There are ranges of severity related to both food security and food insecurity concepts (Table 1.1). Food security encompasses “high food security” and “marginal food

security,” while food insecurity includes “low food security” and “very low food security.” (5) Before 2006, the labels to describe food insecurity’s severity were “food insecure without hunger” and “food insecure with hunger” (2). These labels were recently changed by the U.S. Department of Agriculture (USDA), based on some of the recommendations from the Committee on National Statistics (CNSTAT) of the National Academies (5). The CNSTAT recommendations were based on the premise that the tool that measures food insecurity at the household level does not measure hunger (an individual-level condition) appropriately. Therefore, based on these recommendations, the word “hunger” should not be used to describe more severe levels of food insecurity when using this tool (which will be explained later on under the methodology section) (6,7). Since only the labels have changed and not the methodology on how to assess household food security, the latest statistics are directly comparable with those from previous years (5).

Food insufficiency is a concept related to food insecurity. Food insufficiency is defined as “an inadequate amount of food intake due to lack of money or resources,”(8) and refers to the quantity component of food insecurity (9). It has been previously compared to the concept of food insecurity with hunger (10), also known as “very low food security,” which includes both decreased quantity and quality of available food.

Table 1.1. Old and new food security and food insecurity categories and severity ranges as described by household conditions

			Description of households' conditions			
General Food Security Categories	Severity ranges		No food-access problems	Anxiety over household food shortage	Reduced diet quality, variety, and appeal	Reduced food intake and disrupted eating patterns
	Old label	New label				
Food Security	Food Security	High food security	X			
		Marginal food security		X		
Food Insecurity	Food insecure without hunger	Low food security		X	X	
	Food insecure with hunger	Very low food security		X	X	X

Adapted from Nord, 2006 (5)

History of the Development of Food Insecurity Measures

Even though the concept of hunger has been discussed publicly in the U.S. since the late 1960's and a question regarding households' food sufficiency has been asked on the Nationwide Food Consumption Survey since 1977 (6), the first attempt to measure hunger nationwide was made in the late 1980's by the Food Research and Action Center (FRAC) with the "Community Childhood Hunger Identification Project" (CCHIP) (11). Simultaneously, researchers at the Division of Nutritional Sciences at Cornell University worked towards developing indicators to measure hunger (i.e., the Radimer/Cornell food security measure) (6,12). Finally, in 1990 a consensus was reached on how formally to define food security, food insecurity, and hunger. These definitions were published by the

Life Science Research Office in the Journal of Nutrition (1). In 1992, USDA staff started reviewing the existing research on how to measure food insecurity, and how to develop a single survey that could be used at national, state, and local levels (13).

In 1994 the USDA's Food and Nutrition Service (FNS) and the U.S. Department of Health and Human Services' National Center for Health Statistics sponsored a National Conference on Food Security Measurement and Research (13). In this conference, an appropriate conceptual basis for a national measure of food insecurity was identified, and an agreement on how best to implement this measure in national surveys was attained. After conducting cognitive assessment and field testing of the food security questionnaire, the Food Security Supplement (FSS) was administered as a supplement to the Current Population Survey (CPS) for the first time in 1995 (13). The FFS questionnaire is composed of 50 questions and has been administered annually since 1995, with some minor modifications to the questionnaire format and screening procedures done over the first several years (13).

Included in the FSS is the Household Food Security Survey Module (HFSSM). The HFSSM is a set of 10 questions for households with no children and 18 for households with children, and it is the questionnaire currently used to estimate the prevalence of food insecurity in the United States at the household level (6). The HFSSM can also be used to estimate food insecurity at the individual level if the person interviewed lives alone (14). After 1995, the HFSSM, or a modification of it, has been incorporated into multiple national surveys, such as the National Health and Nutrition Examination Survey

(NHANES), the Survey of Income and Program Participation (SIPP), and the Early Childhood Longitudinal Study (ECLS), as well as on some state-level surveys (6).

Prevalence of Food Insecurity in the United States and Hawai'i

In 2005, 11% of the U.S. households surveyed were food insecure at any given time (15).

Out of the 11% who were food insecure, 7.1% of households had low food security and 3.9% very low food security (15). As for the state of Hawai'i, the prevalence of food insecurity was 7.8% for the years 2003-2005, with 5% having low food security and 2.8% having very low food security (15).

Food insecurity in Hawai'i has significantly decreased when compared to previous years: it was 12.9% in 1996-1998 and 11.9% in 2000-2002 (15). In addition to these data obtained from the CPS annual survey, questions on food security were included in the Hawai'i Health Survey (HHS) conducted by the Hawai'i Department of Health in 1999-2000 (16). The results reported by Baker *et al.* indicate a much higher prevalence of food insecurity for the state of Hawai'i: 16.5%. The variation between studies could be explained by difference in the sample size, the use of a modified 6-item questionnaire, a subset of the HFSSM, and a different coding system (16).

One limitation of all of these surveys was that the exclusion of people without telephone service and homeless families and individuals (15,16). Therefore, all of these surveys underestimated the magnitude of the problem, since the homeless are by definition food insecure (17). It is estimated that there were between 12,000 and 15,000 homeless in the

state of Hawai'i at some point of the year, and at least 6,000 were homeless at any given day (18).

Sociodemographic Determinants of Food Insecurity

Nord *et al.* (15) indicated that the prevalence of food insecurity in the U.S. varied considerably by household types. Groups with rates of food insecurity higher than the 11% national average for 2005 were (15):

- Households with income below the official poverty line of \$19,806 for a family of four (36%)
- Households with children headed by a single woman (30.8%) or a single man (17.9%)
- Black households (22.4%) and Hispanic households (17.9%)

In general, households with children were more food insecure than households with no children (15.6% vs. 8.5%), and the prevalence of food insecurity was higher in principal cities of metropolitan areas and non-metropolitan areas when compared to suburban areas (13.5% and 12% vs. 8.7%) (15). Regionally, the prevalence of food insecurity was higher than the national average in the South (12%), and lower than the national average in the Northeast (9.1), while the Midwest (11%) and West (11%) were close to the national average (15).

Data from Hawai'i indicated that a higher prevalence of food insecurity occurred in households with children when compared to those with no children (21.9% versus 13.2%)

(16). In addition, households with lower income and increased poverty had a higher prevalence of food insecurity (45.2% below poverty level versus above the poverty level 13.5%).

As for ethnicity, Hawaiians and Pacific Islanders were at highest risk of food insecurity, followed by Filipinos. Geographically, the islands of Molokai, Lanai, and Maui had the highest levels of food insecurity, while Oahu had the lowest. However, all the islands had high levels of food insecurity in certain areas (16).

Additional research conducted among immigrants and refugees indicated that language barriers (19-22) and number of years spent in the U.S. (22) may be significant predictors of food insecurity as well. Individuals with marginal English proficiency, as well as those that have spent less time in the U.S. seemed to be at higher risk of food insecurity.

Food Insecurity and Food Program Participation

Data from the 2005 CPS indicated that more than half of U.S. food insecure households received some type of federal food assistance (15). The majority of these households received assistance from the Food Stamp Program (FSP) (35.6%), the National School Lunch Program (32.8%), and the Special Supplemental Program for Women, Infant, and Children (WIC) (12.6%). These data also revealed that the prevalence of very low food security was about twice as high among those receiving food stamps when compared to non-participants (15). Moreover, when compared to food secure households, food insecure households were 17 and 19 times as likely to have obtained food from a food

pantry and to have eaten a meal at an emergency kitchen, respectively (15). Several other studies have found similar associations between food insecurity and participation in different food assistance programs (4,9,16,20,23-26).

Financial Determinants of Food Insecurity

Although food insecurity by definition is the result of financial limitations (2), it appears that factors other than low income are related to food insecurity. Many low-income households are food secure, and a small percentage of non-poor households appear insecure (2). To understand the reason(s) for this dilemma, Nord and Brent (27) analyzed data from the 1995-1997 CPS. One of their hypotheses was that the food insecure middle and high-income households were misunderstanding the questions on the HFSSM, and thus, they were being misclassified as food insecure. However, they found that the response patterns of the middle and high-income households were very similar to those of the low-income households. They concluded that the food insecure households in the middle-to-high income group were food insecure most likely because of unexpected changes in income (e.g., job loss, illness) and unusually high economic needs (e.g., chronic medical condition, high costs of education). They also concluded that intra-household allocation of money was probably the least contributing factor to their food insecurity. Similarly, Brown *et al.*, cited by Rose (28), analyzed data from the 1992 SIPP and found that among those households above the poverty level, 37.5% of the food insufficient had either lost food stamps, lost a job, and/or gained a household member in the previous 8 months, as opposed to 16.5% of the food sufficient.

Anderson and Swanson (4) found that food insecurity was significantly associated with a decreased ability to manage bills, prepare a family budget, and portion groceries to last until the end of the month. In a study conducted among rural families in different states of the U.S., adequate food and financial skills was found to be significantly protective against food insecurity (29). Participating in the Expanded Food and Nutrition Education Program (EFNEP), which includes classes on how to manage food resources, was also associated with decreased food insecurity (30,31). Similarly, Grutzmacher (32) found that the inability to make a family budget was a significant predictor of food insecurity. In Hawai'i, Derrickson (33) reported that budgeting practices were related to food insecurity among Asians and Pacific Islanders.

In a nationwide study on college students conducted by Harris Interactive®, 32% of the upperclassmen students sampled (n=1,003, ages 18-24) reported they were not prepared for managing their money on campus when they were freshmen (34). Fifteen percent also reported that they would usually choose to go out and have fun rather than stay at home and save money. Additionally, 11% of the students reported frequently skipping meals (once to several times a week) due to poor money management, and 31% of the students reported skipping meals for the same reason few times a year to once a month (34).

Dietary Intake as a Consequence of Food Insecurity

The association between food insecurity and dietary intake has been studied at different levels. Food insecurity was associated with decreased food supplies (24,35,36),

compromised diet variety (37,38), decreased food (10,36,39-42) and nutrient intake (10,35,42-45), and low serum nutrients (37,38,46).

Availability of Food Supplies

Studies using household food inventories have found that supplies of grains, vegetables, fruits, meat, dairy (24,35,36), and snack foods (24) significantly declined as food insecurity worsened. Kendall *et al.* (35) found that total food supplies were also lower among food insecure individuals, when compared to the food secure.

Diet Variety

Analysis of NHANES III data found that, among non-elderly adults, food insecure individuals had a less healthy diet (measured with the Healthy Eating Index, HEI) when compared to those food secure (37). In a study conducted among elderly (65 years and above), food insufficiency was also significantly associated with a lower variety of food eaten (38). However, Knol *et al.* (47) reported that, among children 2 to 8 years old living in low-income households, food insufficiency was not related to diet variety.

Decreased Food Intake

NHANES III data indicated that food insufficient adults consumed significantly fewer portions of dairy products, fruits (including fruit juices), vegetables, salty snacks, and desserts/sweets, when compared to food sufficient adults (10). Frongillo *et al.* (39) and Kendall *et al.* (35) reported that food insecure women in New York consumed less fruits and vegetables when compared to their food secure counterparts. In addition to a

decreased fruit and vegetable intake, Tarasuk (40) found that food insecure women in Toronto had a significantly lower intake of meat and meat alternatives, when compared to the food secure. Results from qualitative studies conducted among food insecure Latinos in California (48) and North Carolina (49) also showed a decreased consumption of fruits, vegetables, and meats as a coping strategy, since these food items are typically the most expensive. In Hawai'i, Derrickson and Anderson (41) found that food insecure Asian and Pacific Islanders had a decreased vegetable intake, as well as an increased reliance on the inexpensive saimin soup (dried, fried noodle product), when compared to those who were food secure.

Data from the Continuing Survey of Food Intakes by Individuals (CSFII) indicated that, among children 0 to 17 years old, food insufficiency was associated with a decreased consumption of fruits, refined grains, and yogurt (42). Among Hispanic children, Matheson *et al.* (36) found that food insecurity was significantly associated with a decreased in energy and meat intake as payday approached.

Nutrient Intake

In Toronto, food insecure female welfare recipients had significantly lower intakes of energy and several nutrients, including protein, carbohydrates, vitamin A, folate, iron, magnesium, and zinc, when compared to the food secure (43). Moreover, Kendall *et al.* (35) reported that food insecurity among women in rural New York was associated with a decreased potassium and fiber intake and likelihood of falling short on vitamin C recommendations. Likewise, food insufficiency has been associated with decreased

calcium intake among adults (10) and decreased consumption of energy, vitamins A, E, C, B₁, and B₆, niacin, and magnesium among women (44). As for elders (65 years and above), food insufficiency has been associated with decreased intakes of protein, niacin, vitamins B₆ and B₁₂ (44,45), energy, carbohydrates, magnesium, iron, and zinc (45), vitamins A, B₁, and B₂, and calcium (44).

Serum Nutrients

Using NHANES III data, food insecure adults, when compared to those food secure, were found to be low in serum folate, as well as vitamins A and C (37). Similarly, data from NHANES III indicated that food insufficient elders (65 years and older), when compared to their food sufficient counterparts, were significantly more likely to have low serum levels of folate, vitamins C and E, and some carotenes, (38). A study conducted on children from Vancouver indicated that food insecurity was associated with low median serum zinc (46).

Being Overweight and Obese as a Consequence of Food Insecurity

Food insecurity has been associated with overweight and obesity in adults (16,37,39,50-58). However, a number of these studies have found this association only among women (50-58). In children, the relationship between food insecurity and/or insufficiency and being overweight and obese is not clear. Some studies have found that food insecure and insufficient children were at higher risk of being overweight or obese when compared to the food secure (42,59,60), while others indicated that the food secure were the ones at higher risk of overweight and obesity (36,61,62). Alaimo *et al.* (63), on the other hand,

found no consistent trend in the relationship between overweight and food insufficiency status among children.

Adverse Health Outcomes as Consequences of Food Insecurity

Self-Reported Health Status

Several studies have linked adverse health outcomes and food insecurity. Stuff *et al.* (64) reported that household food insecurity was associated with poor self-reported health status in adults in the Lower Mississippi Delta area. Similar findings have been found among low-income women in Toronto (40), rural Appalachians (65), and children 0 to 3 years old (66,67). In a study conducted with families participating on EFNEP in Tennessee (30), a higher proportion of subjects reporting fair or poor health were food insecure. Some of the physical manifestations of food insecurity (i.e., fatigue, illness related to insufficient food) could translate into a lack of concentration and low work capacity (68). Similarly, studies have found associations between food insufficiency and poor self-reported health among the elderly (38,45), women who were welfare recipients (69), and children (70). Vozoris and Tarasuk (71) found that, among Canadians, individuals from food insufficient households were more likely to report having poor/fair health, poor functional health, restricted activity and multiple chronic conditions, when compared to their counterparts.

Food insecurity has also been associated with iron deficiency anemia (IDA) among children 1 to 3 years old (72), and with poor physical function and lower child health-related quality of life (73). Specifically in Hawai'i, it was found that adults that reported

poorer physical health were more likely to live in a food insecure household, and that food insecurity was associated with diabetes, asthma, and arthritis (16).

Mental Health and Performance

Food insecurity has been associated with maternal depression (29,74), social isolation (40), poor mental health (64), and disrupted household dynamics (especially in the parent-child relation) (68). Whitaker *et al.* (75) found that depression and anxiety increased with the level of maternal food insecurity, and that maternal food insecurity was in turn associated with child behavioral problems (i.e., aggressiveness, anxiety, depression). Similarly, food insufficiency has been linked to major depression among welfare recipient women (69,76). A study among Canadians also found food insufficiency to be associated with poor social support, major depression, and distress (71).

Results from the NHANES III (77) reported a strong association between food insufficiency and depressive disorder and suicidal symptoms in U.S. adolescents. In addition, negative academic and psychosocial outcomes were associated with family-level food insufficiency among American school-aged children (78).

Finally, data from the CCHIP reveals that hunger is associated with psychosocial dysfunction, behavioral and attention problems, as well as academic problems in children (79). Kleinman *et al.* (80) analyzed a subset from the CCHIP study in Pittsburgh and found that hungry children were more likely to be classified as dysfunctional, to be

receiving special education services, and to have a history of mental health counseling, when compared to those not hungry. Another study using items from the CCHIP found that child hunger was related to anxiety and depression, and that severe child hunger was associated with chronic illness and psychiatric distress (81). Jyoti *et al.* (59) found that food insecurity (including marginal food security) predicted school-aged children's impaired academic performance in reading and math and a larger decline in social skills for boys.

Food Insecurity among College Students

To our knowledge, only three unpublished undergraduate research projects have studied food insecurity in a University campus setting. One study focused on food security in the context of having a sustainable campus food system (82). The other two studies measured the students' prevalence of food insecurity. One of these studies was conducted at Ohio University (David Holben PhD, personal communication, October 11, 2005), and the other study was conducted at the University of Hawai'i at Mānoa (UHM) (Sahar Zaghoul PhD, personal communication, September 5, 2005). The study carried out at UHM was done as a pilot study conducted among students taking an introductory nutrition course during the 2005 Spring semester. The results of this study indicated that 14.5% of the students were marginally food secure and 22% were food insecure (13% had low food security, and 9% very low food security) (Sahar Zaghoul PhD, personal communication, September 5, 2005). The prevalence of food insecurity among UHM students, based on this pilot study, was twice as high as the U.S. average for the year 2005 (11%), and almost 3 times higher than the average for the state of Hawai'i for the

years 2003-2005 (7.8%) (15). The sample used was not representative of the whole University. However, it clearly indicated a possible problem among UHM students that needed to be addressed.

Goals and Objectives

The goal of the present study was to investigate food insecurity among college students at the University of Hawai'i at Mānoa (UHM).

The specific objectives were:

1. To assess the prevalence of food insecurity among UHM students; and
2. To determine the predictors and consequences of food insecurity among UHM students (Figure 1.1).

We hypothesized that the prevalence of food insecurity among UHM students would be higher than the prevalence observed for the state of Hawai'i. Also, in terms of demographic predictors, we hypothesized that: 1) students living on campus, alone and/or with roommates would be more food insecure than those living with their parents or relatives; 2) students participating on a school meal plan would be more food insecure than those not participating; and 3) students identifying themselves as Native Hawaiians or Pacific Islanders would be the most food insecure.

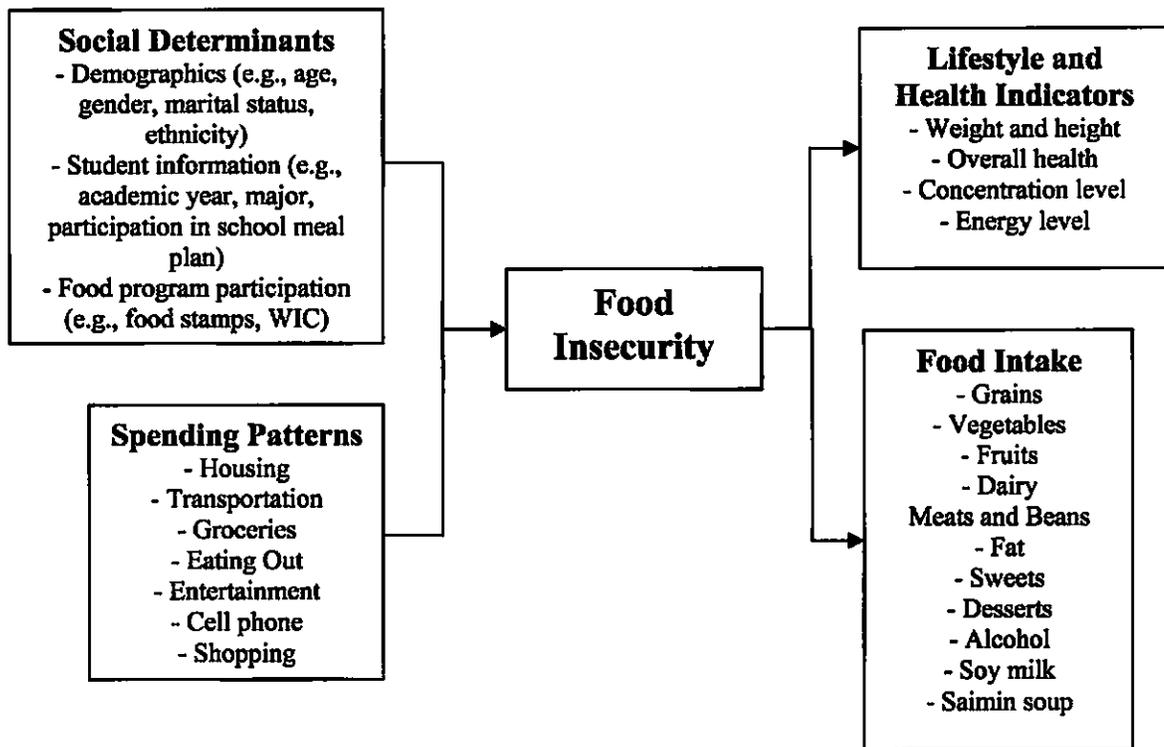


Figure 1.1. Potential predictors and consequences of food insecurity among UHM students

For the spending patterns data, we hypothesized that: 1) there is a difference in the amount of money spent in groceries between food secure and insecure students; and 2) there is a difference in the amount of money spent on discretionary items, such as cell phone, shopping, and entertainment between the food secure and insecure.

In terms of dietary data, we hypothesized that, when compared to food secure UHM students, UHM students suffering from food insecurity, would consume fewer portions of vegetables, fruits, and meats. In addition, food insecure UHM students would consume more portions of saimin (ramen) soup, which is a local inexpensive food.

Finally, we hypothesized that food insecure students would be: 1) more likely to be overweight and obese; and 2) more likely to report poor health, concentration, and energy levels.

CHAPTER 2

METHODOLOGY

Study design

The design is an observational, cross-sectional study.

Target population and sample size calculation

The target population chosen for this study was classified, non-freshmen students at the University of Hawai'i at Mānoa (UHM). The food security questionnaire focuses on the food security experience during the previous year; therefore, freshmen were excluded to reflect the college life experience. A description of UHM students can be found in Figure 2.1 and Table 2.1.

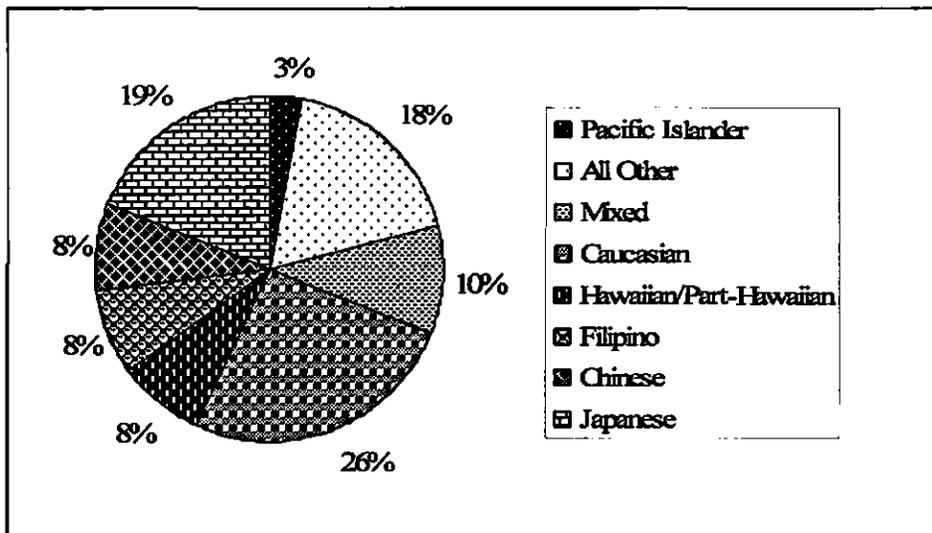


Figure 2.1. Distribution of UHM students by ethnicity

Source: University of Hawai'i at Mānoa, 2006 (83)

Table 2.1 Distribution of UHM students by level of education

Student Enrollment	Number	Percent (%)
Undergraduates	14,356	70
Graduates	6,288	30
Total	20,644	100

Source: University of Hawai'i at Mānoa, 2006 (83)

We estimated that a sample size of 450 students was necessary to detect a statistically significant difference of 5% between the prevalence of food insecurity among UHM students and Hawai'i residents (7.8%) (80% power and alpha = .05). The study questionnaire was returned by 441 students with a 99% response rate.

Recruitment

This study was approved by the University of Hawai'i Committee on Human Subjects.

To obtain a representative sample of students, a stratified random list of courses offered in the 2006 Fall semester was generated. To capture non-freshmen students, the strata only included 200, 300, 400, and graduate-level courses. The list of classes was obtained from the UHM Registration Homepage 'Fall 2006 Check Class Availability' (84).

Classes to be surveyed were chosen using a random number generator in Microsoft Excel.

The recruitment process summary can be found in Figure 2.2 and the response rates by stratum are shown in Table 2.2. Briefly, instructors from the randomly selected courses were emailed requesting participation by their students. If an instructor approved, a date and time to administer the questionnaire in the last 15 minutes of the class was scheduled.

In the classroom, the study was explained to the students verbally, and an informed consent was distributed along with the questionnaire. The survey was administered over a 2-month period (October and November 2006). The majority (75%) of the instructors that refused to participate in this study indicated lack of time.

Survey Instrument

The survey used for this study included five components (See survey in Appendix A):

- Food security-related questions (Sections 1-6)
- Social determinants contributing to food security (demographic data)
- Spending patterns (Section 8)
- Dietary intake (Section 7), and
- Lifestyle characteristics and health determinants (Section 7)

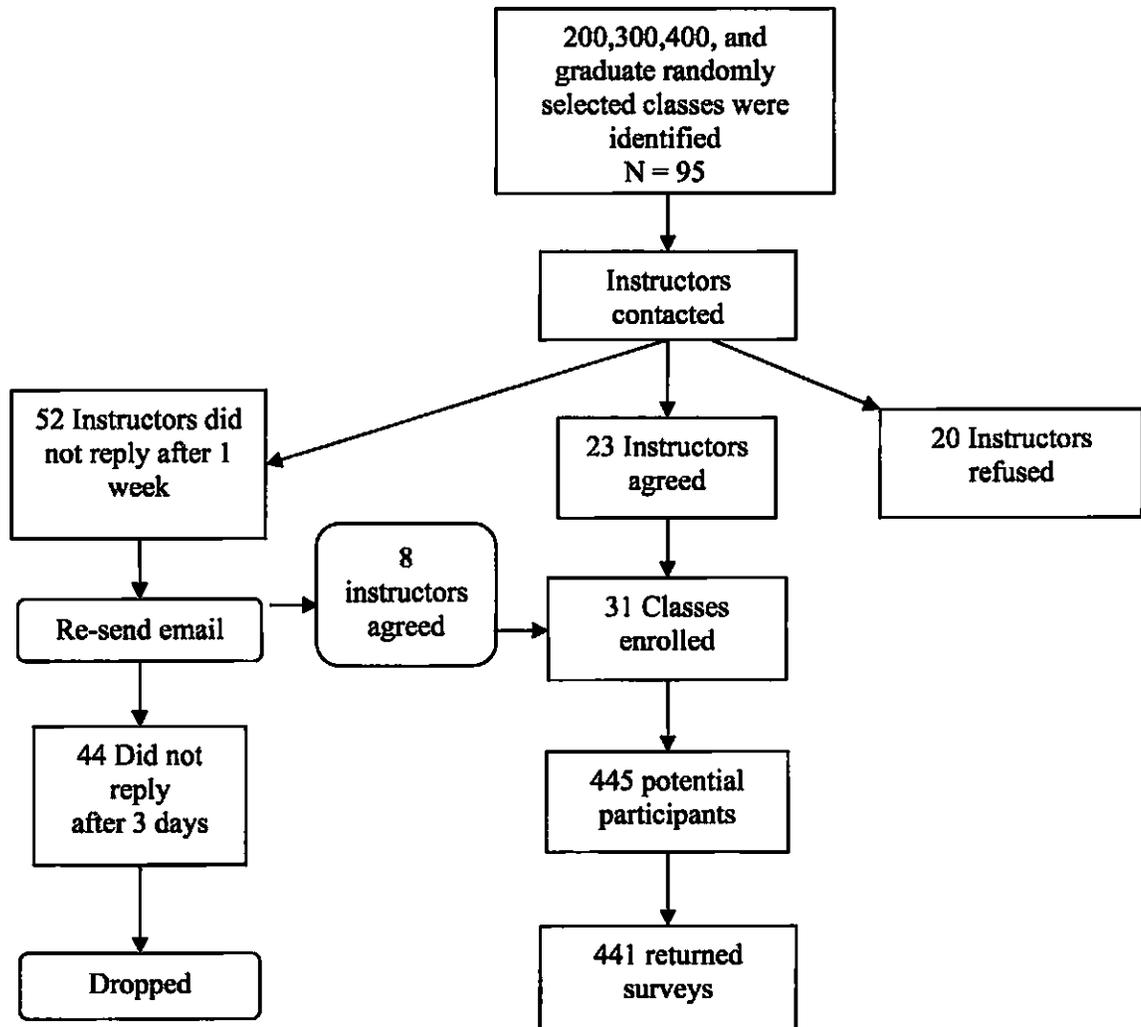


Figure 2.2. Summary of the recruitment process

Table 2.2. Summary of data collection by class level stratum

Stratum	Instructors contacted (n)	Instructors agreed		Students in class (n)	Students returning the survey	
		(n)	(%)		(n)	(%)
200	17	5	29	93	92	99
300	22	5	23	99	99	100
400	15	7	47	98	98	100
graduate	41	14	34	155	152	98
TOTAL	95	31	33	445	441	99

Food Security

Questions related to food security, obtained from the 1999-2000 NHANES (85), included: 1) a food sufficiency indicator, 2) the Household Food Security Survey Module (HFSSM), and 3) questions about Food Programs Participation. The HFSSM is composed of 18 questions, 10 if there are no children in the household. To characterize households with difficulty meeting basic food needs, each question addressed conditions and behaviors that may have occurred during the previous 12 months. The questions specified lack of money or other resources to obtain food. Therefore, voluntary fasting and/or dieting to lose weight were excluded from the measure (2). Following standard procedures (2), affirmative responses to the HFSSM were summed and the score was translated into a categorical measure, which included four food security categories, as shown in Table 2.3 (5).

Table 2.3. Household food security categories based on the number of affirmative responses

Affirmative responses¹	Categories (Food security status)
0	High food security
1-2	Marginal food security
3-5 (households with no children) 3-7 (households with children)	Low food security
> 5 (households with no children) > 7 (households with children)	Very low food security

¹ Number out of 10 questions for households with no children; number out of 18 questions for households with children
Adapted from Nord, 2006 (5)

Derrickson found that the HFSSM was valid and reliable for Asians and Pacific Islanders living in Hawai‘i (33). To assure that the HFSSM would also be valid with college-age students, a face-validation pilot test was conducted at UHM during the 2006 summer semester. A convenience sample of nine students from different majors and academic years participated in the study¹. Students were asked to fill out the questionnaire independently and then as a group to openly discuss all of the questions. Each question was assessed for clarity. The session was audiotaped to ensure that the comments of the students were captured correctly. Suggestions and clarifications were included in the final questionnaire (details of these changes can be found in Appendix B).

¹ The majority of the students who participated in the pilot-testing study were graduate students (6 graduates vs. 3 undergraduates). Three of the students were majoring on Animal Sciences, one on Nutritional Sciences, one on Zoology, one on Meteorology, one on Mechanical Engineering, one on Communications, and one on Marine Biology.

Social Determinants

Demographic data asked in the questionnaire included age, gender, marital status, number of children, ethnicity, major, academic year (i.e., sophomore, junior, etc), living arrangement, participation in a campus meal plan, place of birth, and length of residency in Hawai'i.

Student's Spending Patterns

Students were asked to report on the amount of money they spend during an average month on various categories. These included housing, transportation, food (groceries and eating out), entertainment, cell phone, and shopping for other items (e.g., clothes, shoes, household items). Additionally, they were asked if they had any large expense such as tuition, schoolbooks, and travel in the past year. The amount of money spent on each group was categorized into ranges. For example, housing ranges were \$0-500, \$501-750, \$751-1000, \$1001-1500, and >\$1500. Students were also asked how much money they have available to spend each month.

Dietary Data

To obtain a general idea of what students were eating, a short dietary intake questionnaire was developed. The questionnaire asked students to recall the amount of food from each food category consumed the previous day. Each question provided equivalent guides (e.g., 1 portion of grains equals to 1 slice bread, 1 cup ready-to-eat cereal, and ½ cup of rice, hot cereal or pasta; see survey in Appendix A for more examples). The food groups included were grains, vegetables, fruits, dairy, and meats and beans. Additional questions

estimating amount of fat, sweets, desserts, and alcoholic beverages consumed were asked. Also listed were soymilk and saimin/ramen soup since we anticipated high consumption of these two foods among this population. Additionally, students were asked to define if their intake the previous day was usual, more than usual, or less than usual.

Lifestyle Characteristics and Health Determinants

Questions under the lifestyle characteristics included weight and height. These were used to calculate each student's Body Mass Index (BMI) by dividing the students weight in kilograms by their height in meters squared ($BMI = Kg/m^2$). Additional questions included body perceptions, exercise, usual mode of transportation, whether or not students were presently on a weight loss diet, whether or students took dietary supplements (i.e., vitamins and minerals), and whether or not they were vegetarians. To determine if the students were actually vegetarians, a question on the students' preferred dietary habits was asked (see Appendix A, question 5 in section 7 for more details). For analyses, only the students who responded that they were either vegans or vegetarians eating no meat, poultry, or fish were considered vegetarians. Appendix C shows a description of all those students who identified themselves as vegetarians.

Additionally, students were asked to report on their perceived overall health status, concentration, and energy level. For these three health indicators, students were asked to choose from a 5-point Likert scale: very good=5, good=4, fair=3, poor=2 and very poor=1.

Data Management

For determining the prevalence of food insecurity and for each successive analysis that involved a comparison between food insecurity and different characteristics, 33 participants were excluded for the following reasons. These included being a freshmen (n=3) or an unclassified student (n=5), being on a special diet because of illness (n=8), being pregnant (n=1), or not completing the HFSSM core questions (n=16). With these exclusions, the sample was reduced to 408 valid surveys. For determining the prevalence of food insufficiency, additional surveys were excluded because of incomplete/invalid answers to the food sufficiency question (final n=395).

For certain analyses, students were excluded because of missing or incomplete data relating specifically to that analysis. For example, for the comparison of dietary intake between food security categories, 13 students were excluded in addition to the original 33. As shown in figure 2.3, there were 10 students who left the entire question blank (had zero responses out of 11). Food intake data indicating less than three food categories consumed on the previous day were considered invalid and were eliminated from analysis (n=13). Thus, the sample size for the dietary intake sub-analysis is 395.

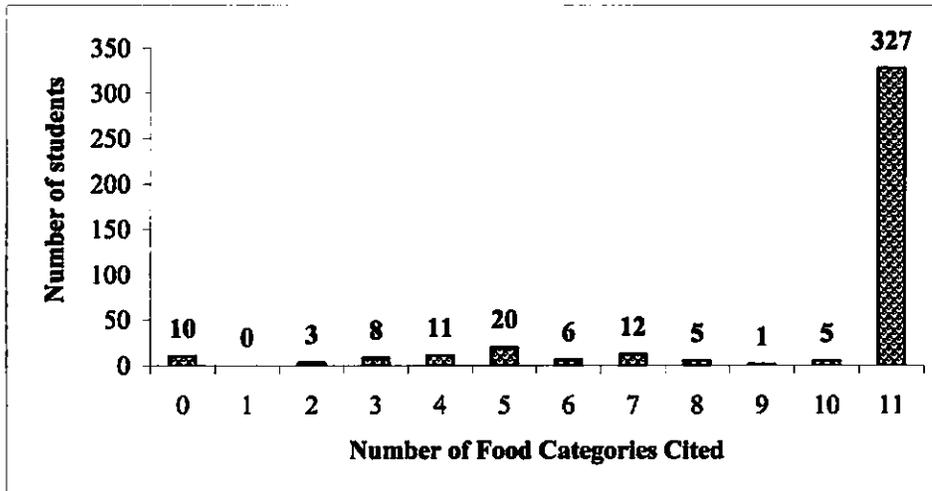


Figure 2.3. Frequency of students by number of food categories, after exclusion of food security missing data

In addition to analyzing the difference in spending patterns by food security status, the percent of money students' allocated to each of the spending areas (housing, transportation, groceries, eating out, entertainment, cell phone, and shopping) was calculated. To calculate these percentages, the total amount of money each student reported spending in an average month was estimated, since income data was not available. This total amount was estimated by summing the median of each spending category range reported by the students (e.g., if the student chose the lowest range in each spending category, the total amount spent was calculated as follows: 250 (housing) + 25 (transportation) + 25 (groceries) + 25 (eating out) + 25 (entertainment) + 15 (cell phone) + 25 (shopping) = 390). The percent spent in each category was then calculated from the estimated total (e.g., $250/390 * 100 = 64\%$ spent for housing, $25/390 * 100 = 6\%$ spent for transportation, etc.).

In addition to analyzing the difference in food intake by food security status, students' reported food intake was compared with current recommendations by using the USDA MyPyramid's food intake pattern by caloric levels (86,87). Individuals were assigned to a caloric level based on their age, gender, and activity level (Table 2.4). Caloric levels were then translated into suggested amounts of food from each food group (Table 2.5).

Table 2.4. Estimated energy needs (Kcal) based on age, gender, and physical activity

Age (years)	Males			Females		
	Inactive ¹	Moderately Active ²	Active ³	Inactive ¹	Moderately Active ²	Active ³
18	2400	2800	3200	1800	2000	2400
19-20	2600	2800	3000	2000	2200	2400
21-25	2400	2800	3000	2000	2200	2400
26-30	2400	2600	3000	1800	2000	2400
31-35	2400	2600	3000	1800	2000	2200
36-40	2400	2600	2800	1800	2000	2200
41-45	2200	2600	2800	1800	2000	2200
46-50	2200	2400	2800	1800	2000	2200

¹ Inactive = < 30 minutes a day of moderate physical activity in addition to daily activities

² Moderately active = at least 30 minutes up to 60 minutes a day of moderate physical activity in addition to daily activities

³ Active = 60 or more minutes a day of moderate physical activity in addition to daily activities

Source: USDA, 2005 (86)

Students' reported intake was compared to MyPyramid's recommended food amounts, and the percent of the recommendation attained was calculated for each food group (reported in quartiles). Additionally, the number of students reaching 100% or more of the recommendations for all food groups was calculated by food security status. For calculating the percent of the recommendation attained for the grain group, the number of saimin/ramen soup packages reported on the survey was converted to ounce equivalents

and added to the grains group. One package of saimin/ramen group was considered as 3.7 grain-ounce equivalents, based on MyPyramid information. In addition, soymilk was considered part of the dairy group to calculate percent of recommendations attained

Table 2.5. Suggested amount of food needed from each food group, based on MyPyramid's caloric levels

Food Groups	Energy Level (Kcal)					
	1800	2000	2200	2400	2600	2800
Grains (ounce equivalents) ¹	6	6	7	8	9	10
Vegetables (cups)	2.5	2.5	3	3	3.5	3.5
Fruits (cups)	1.5	2	2	2	2	2.5
Milk (cups)	3	3	3	3	3	3
Meats and Beans (ounce equivalents) ²	5	5.5	6	6.5	6.5	7
Oils (teaspoons)	5	6	6	8	8	8

¹ One ounce equivalent grains = 1 slice of bread, 1 cup of ready-to-eat cereal, or 1/2 cup of cooked rice, pasta, or cooked cereal

² One ounce equivalent meats and beans = 1 ounce of lean meat, poultry, or fish, 1 egg, 1 Tbsp. peanut butter, 1/4 cup cooked dry beans, or 1/2 ounce of nuts or seeds

Source: USDA, 2005 (87)

Statistical Analyses

Data were entered into a Microsoft Access database, with an interface constructed for this survey. Queries were utilized to count the number of participants per food security category (based on their food security score), as well as the number of students who were food sufficient vs. food insufficient. The latter was determined by the students' answer to the food sufficiency indicator, as shown in Table 2.6 (8). Students' demographic characteristics, dietary intake, health measures, and spending patterns by food security status were described in means and frequencies.

Table 2.6. Food sufficiency levels based on response to the food sufficiency indicator

Responses	Levels of Food Sufficiency
"I always have enough to eat and the kinds of food I want"	Sufficient
"I have enough to eat but not always the kinds of food I want"	Sufficient
"Sometimes I don't have enough to eat"	Insufficient
"Often I don't have enough to eat"	Insufficient

Data were analyzed with SPSS® version 15.0 for Windows. Descriptive statistics were used to estimate the prevalence of food insecurity, food insufficiency, and characteristics of the sample. Differences between food security levels were tested by performing chi-square, ANOVA, and linear-by-linear association analyses, with significance specified as a p value < 0.05 . Chi-square was used for analyzing categorical data (e.g., gender, level of education, living situation), and ANOVA for analyzing continuous/ordinal data (e.g., age, dietary intake). Linear-by-linear association analyses were used to analyze trends in spending patterns by food security categories.

To estimate the risk of being food insecure, odds ratios and 95% confidence intervals with a significance level of $p < 0.05$ were calculated for all variables found to be significant in the descriptive statistics' analyses. Logistic regression analyses were performed by dichotomizing the food security variable into food security (high food security + marginal food security) and food insecurity (low food security + very low food security).

Multivariate logistic regression analyses were performed to analyze the association of individual factors and food security status. Five models were created with variables that were found to be significant in univariate analyses. Two models were constructed with food insecurity as the dependent variable and demographic characteristics and spending patterns as the independent variables. Three models estimated the consequences of food insecurity on students' overall health, concentration level, and energy level, with food security as the independent variable. Model 1 tested the impact of living arrangement, students' place of birth, ethnicity, and years of residency in Hawai'i on food insecurity, while adjusting for gender, marital status, and having children. Model 2 was performed to predict spending categories on food insecurity after adjusting for gender, marital status, having children, living arrangement, and ethnicity. Models 3, 4, and 5 examined simultaneously the additive effects of food security level, gender, marital status, and having children on health conditions (health status, concentration level, and energy level).

CHAPTER 3

SOCIAL DETERMINANTS OF FOOD INSECURITY AMONG COLLEGE STUDENTS AT THE UNIVERSITY OF HAWAI'I AT MĀNOA (UHM)

Food insecurity “exists when there is limited or uncertain availability of nutritionally adequate and safe foods or limited or uncertain ability to acquire acceptable foods in socially acceptable ways” (1). The objectives of this study were to determine the prevalence of food insecurity among UHM students and to determine sociodemographic factors that predict food insecurity among these students.

We hypothesized that the prevalence of food insecurity among UHM students would be higher than the prevalence observed for the state of Hawai'i. Also, we hypothesized that: 1) students living on campus, alone and/or with roommates would be more food insecure than those living with their parents or relatives, 2) students participating in school meal plan would be more food insecure than those not participating, and 3) students identifying themselves as Native Hawaiians or Pacific Islanders would be the most food insecure.

Results

The results of this study indicated that the overall prevalence of food insecurity among UHM students surveyed was 21% (15% low food secure and 6% very low food secure) (Figure 3.1). One out of four students reported having one or two indicators of food insecurity, classifying them as marginally food secure.

Food insufficiency, an inadequate amount of food intake due to lack of money or resources, was reported by 4% of the students (n=17). However, 44% of the students (n=174) reported “having enough to eat but not always the kinds of food they want.” The most commonly reported explanation was not having enough money (n=98) and difficulty getting to food stores (n=91) (Appendix D).

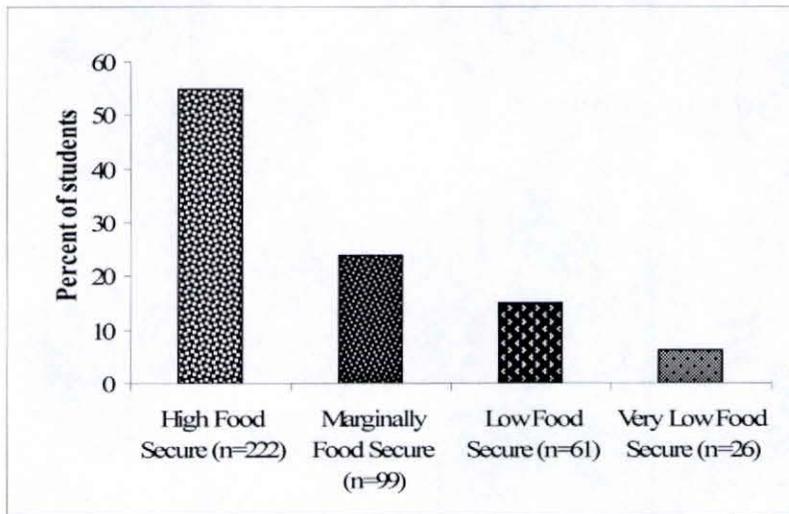


Figure 3.1. Food security status among UHM students

Table 3.1 shows the demographic characteristics of the sample, as well as the characteristics of the students based on their food security status. The average age of the sample was 26 ± 6 years (range= 18-56 years); 57% were females, 86% were single, and 10% had children. Most of the students were undergraduates (62%) and reported living off-campus (88%). Thirty percent of the students reported living with their parents or relatives, 7% were enrolled in a school meal plan and 59% were not born in Hawai'i. The prevailing ethnicity was White (26%), followed by Japanese (19%).

A total of 20 students (5%) reported participating in food assistance programs: two percent reported receiving benefits from the Women, Infants and Children (WIC) Program (n=8), two percent being authorized to receive Food Stamps during the past year (n=8), two percent getting emergency food from a church, food pantry, food bank, or community kitchen (n=9), and one percent receiving food from private organizations (n=3) (Appendix E). Only four students reported getting assistance from two or more of the above assistance programs. Due to a small sample size, this data was not further analyzed.

Two demographic characteristics were statistically significantly different between the food secure and food insecure groups. These characteristics included place of birth and years residing in Hawai'i (Table 3.1).

Since more than 20% of the expected cell values for living arrangement, ethnicity, and participation on a school meal plan were less than five, chi-square analyses with the four food security categories were not performed. Instead, chi-square analyses were done by dichotomizing the food security variable to food security (high food security + marginal food security) and food insecurity (low food security + very low food security). Only living arrangement and ethnicity were significantly associated with food insecurity ($p = 0.001$).

Table 3.1. Distribution of students' demographic characteristics by food security status¹

Demographic Characteristics	Total	High Food Secure	Marginally Food Secure	Low Food Secure	Very Low Food Secure	Significance
Age (years) Mean (SD)	26 (6)	26 (6)	25 (6)	25 (6)	25 (5)	NS
Gender, n (%)						NS
Female	230 (57)	132 (57)	56 (24)	31 (14)	11 (5)	
Male	176 (43)	88 (50)	43 (24)	30 (17)	15 (9)	
Marital Status, n (%)						NS
Single	349 (86)	186 (53)	86 (25)	55 (16)	22 (6)	
Married	57 (14)	34 (60)	13 (23)	6 (10)	4 (7)	
Children, n (%)						NS
Yes	40 (10)	22 (55)	7 (18)	7 (18)	4 (10)	
No	368 (90)	200 (54)	92 (25)	54 (15)	22 (6)	
Level of Education, n (%)						NS
Undergraduates	245 (62)	122 (50)	64 (26)	44 (18)	15 (6)	
Graduates	147 (38)	85 (58)	35 (24)	16 (11)	11 (7)	
Living Arrangement, n (%)						*
On campus	50 (12)	19 (38)	12 (24)	16 (32)	3 (6)	
Off-campus unknown	47 (12)	24 (51)	10 (21)	9 (19)	4 (9)	
Off-campus alone	42 (10)	25 (59)	10 (24)	4 (10)	3 (7)	
Off-campus w/parents	122 (30)	82 (67)	25 (20)	13 (11)	2 (2)	
Off-campus w/roommates	71 (17)	27 (38)	22 (31)	13 (18)	9 (13)	
Off-campus with spouse	76 (19)	45 (59)	20 (26)	6 (8)	5 (7)	
On School Meal Plan, n (%)						*
Yes	29 (7)	13 (45)	8 (27)	6 (21)	2 (7)	
No	364 (93)	199 (55)	87 (24)	54 (15)	24 (6)	
Place of birth, n (%)						p= 0.010
From Hawai'i	168 (41)	99 (59)	39 (23)	23 (14)	7 (4)	
From mainland USA	114 (29)	59 (52)	25 (22)	15 (13)	15 (13)	
Another country	116 (30)	57 (49)	35 (30)	21 (18)	3 (3)	
Years of residency in HI Mean (SD)	14 (11)	15 (11)^a	14 (11)^a	12 (11)^{ab}	9 (11)^b	p= 0.046

Table 3.1. (Continued) Distribution of students' demographic characteristics by food security status¹

Demographic Characteristics	Total	High Food Secure	Marginally Food Secure	Low Food Secure	Very Low Food Secure	Significance
Ethnicity, n (%)						*
Chinese	44 (11)	22 (50)	15 (34)	6 (14)	1 (2)	
Filipino	42 (10)	15 (36)	12 (28)	13 (31)	2 (5)	
Native Hawaiians and Pacific Islanders	16 (4)	4 (25)	5 (31)	5 (31)	2 (13)	
Japanese	77 (19)	53 (69)	18 (23)	6 (8)	0 (0)	
Korean	15 (4)	9 (60)	4 (27)	2 (13)	0 (0)	
White	105 (26)	59 (56)	21 (20)	12 (12)	13 (12)	
Two or more ethnicities	70 (17)	37 (53)	13 (18)	14 (20)	6 (9)	
Other	34 (9)	20 (59)	9 (26)	3 (9)	2 (6)	

¹ Total number of valid surveys = 408. Numbers may vary because of missing data; percentages represent row totals.

* Chi-square analyses with four food security categories were not performed due to small sample size in each cell.

^{a,b} Values with different letters are significantly different from each other (Duncan's test)

Unadjusted odds ratios were calculated for the significant demographic variables, by using food security as a dichotomous variable (food security/food insecurity) (Table 3.2).

Bivariate analyses revealed that students who live on campus, students who live off-campus but did not specify their living arrangement (off-campus unknown), and students who live off-campus with roommates were more likely to be food insecure, when compared to students living with their parents or relatives (1.29 times, 1.17 times, and 1.21 times, respectively). In contrast, the number of years lived in Hawai'i was negatively associated with food insecurity. As for ethnicity, Whites, Filipinos, Native Hawaiians and Pacific Islanders, as well as students reporting two or more ethnicities, had significantly higher odds of being food insecure, when compared with Japanese students (Table 3.2). Japanese were previously described as the most food secure (16) and therefore, were chosen as the reference category in the current study.

Table 3.2. Unadjusted odds ratios for selected demographic characteristics among food insecure versus food secure students

Outcome variable	OR¹	95% CI	p- value²
Living Arrangement (n=408)			
On campus (n=50)	1.29	1.12-1.50	0.001
Off-campus unknown (n= 47)	1.17	1.01-1.34	0.032
Off-campus alone (n=42)	1.04	0.92-1.19	0.499
Off-campus with roommates (n=71)	1.21	1.07-1.36	0.003
Off-campus with spouse/partner (n=76)	1.02	0.93-1.13	0.664
Off-campus with parents/relatives (n=122)	1.00*		
Place of birth (n= 398)			
Mainland US (n=114)	1.64	0.92-2.92	0.090
Another country (n=116)	1.20	0.66-2.18	0.550
Hawai'i (n=168)	1.00*		
Years of residency in Hawai'i (n=387)	0.97	0.95-0.99	0.011
Ethnicity (n=403)			
Chinese (n=44)	2.24	0.70-7.14	0.174
Filipino (n=42)	6.57	2.31-18.69	0.000
Korean (n=15)	1.82	0.33-10.02	0.491
Native Hawaiian and Pacific Islanders (n=16)	9.21	2.53-33.50	0.001
White (n=105)	3.70	1.43-9.53	0.007
Two or more ethnicities (n=70)	4.74	1.77-12.63	0.002
Other (n=34)	2.04	0.58-7.21	0.268
Japanese (n=77)	1.00*		

¹ Unadjusted Odds Ratio

² p-value <0.05 is statistically significant

* Reference category

A multivariate model was developed including all the significant factors related to food insecurity while adjusting for gender, marital status and having children (Table 3.3).

Living arrangement, years of residency in Hawai'i, and ethnicity were still significant predictors of food insecurity. The influence of living conditions and ethnicity were exaggerated in the multivariate model when compared with bivariate results. The protective effect of years residing in Hawai'i also increased slightly in the multivariate model.

Table 3.3. Multivariate logistic model predicting likelihood of being food insecure by sociodemographic characteristics¹

Outcome variable	B	OR ²	95% CI	p-value ³
Intercept	-2.45			0.018
Gender				
Male (n=157)	0.566	1.76	1.01-3.06	0.044
Female (n=216)	0*	1.00		
Marital Status				
Single (n=322)	0.671	1.96	0.59-6.44	0.270
Married (n=51)	0*	1.00		
Children				
Yes (n=34)	1.176	3.24	1.03-10.16	0.044
No (n=339)	0*	1.00		
Living arrangement				
On campus (n=44)	1.356	3.88	1.51-9.96	0.005
Off-campus unknown (n=40)	1.401	4.06	1.46-11.29	0.007
Alone (n=40)	0.611	1.84	0.61-5.74	0.288
With roommates (n=65)	1.341	3.82	1.55-9.42	0.004
With spouse/partner (n=69)	0.517	1.68	0.60-5.70	0.360
With parents/relatives (n=115)	0*	1.00		
Place of birth				
Mainland USA (n=101)	-0.714	0.49	0.15-1.64	0.246
Another country (n=108)	-1.133	0.32	0.10-1.07	0.065
Hawai'i (n=164)	0*	1.00		
Years of residency in Hawai'i	-0.074	0.93	0.88-0.98	0.010
Ethnicity				
Chinese (n=42)	0.839	2.31	0.62-8.62	0.211
Filipino (n=39)	1.678	5.35	1.68-17.08	0.005
Korean (n=14)	0.160	1.17	0.18-7.68	0.868
Native Hawaiian and Pacific Islanders (n=15)	2.436	11.43	2.64-49.50	0.001
White (n=91)	0.652	1.92	0.59-6.23	0.278
Two or more ethnicities (n=68)	1.453	4.28	1.49-12.27	0.007
Other (n=31)	-0.030	0.97	0.24-4.01	0.967
Japanese (n=73)	0*	1.00		

¹ Total sample = 373

² Adjusted for gender, marital status, and having children

³ p-value <0.05 is statistically significant

* Set to zero because this parameter is redundant (reference category)

Discussion

Forty five percent of UHM students surveyed were either food insecure (21%) or at risk of being food insecure (24%). The prevalence of food insecurity among UHM students (21%) was nearly three times of that reported by the USDA for the state of Hawai'i for the years 2003-2005 (7.8%) (15). The 21% prevalence of food insecurity on campus was also slightly higher than the prevalence found among Hawaiian residents reported by the Hawai'i Health Survey (HHS) for the years 1999-2000 (16.5%) (16). In this study, we used an 18-item questionnaire known as the Household Food Security Survey Module (HFSSM) to determine the prevalence of food insecurity among UHM students. The HFSSM is the same tool used by the USDA (15). The HHS, however, used a six-question food security questionnaire that was previously validated against the HFSSM, and also used a different coding system (16). Therefore, it would be more appropriate to compare our findings with the lower USDA results.

In our study, students who live on campus, off-campus unknown and off-campus with roommates were significantly more likely to be food insecure, when compared to those living with their parents or relatives. To our knowledge, no other study has published data on food insecurity in a college campus setting; therefore, there is limited literature to compare our results. However, since high housing costs have been previously associated with food insecurity (19), and Honolulu was ranked the third most expensive place to live in the nation (88), it is reasonable to assume that students living with their parents, relatives and spouses spend less on housing than those under other living arrangements and hence, would be more food secure.

Campus housing fees for the academic year 2007-2008 range from \$3,300 to \$5,967 per person (~\$367 to \$663 per month) (89). All students living in dormitories, but not on campus apartments, are required to purchase a school meal plan, which range in price from \$261 (1 meal per day + ~\$62.5 in retail points²) to \$424 (2.7 meals per day + ~\$25 in retail points) per month (89). In the current study, only 29 students reported participating in a school meal plan. We found no significant association between food security status and participation on a school meal plan. However, eight of those who were food insecure purchased a school meal plan.

Another factor that could explain increased food insecurity among students living on campus and those living off-campus with roommates is limited transportation. Nearly one fourth of students (23%) reported that it was “too hard to get to the store” as one of the reasons they did not have the type of foods they wanted to eat, or they sometimes or often did not have enough to eat.

Years of residency in Hawai‘i was another demographic characteristic associated with food security. For every year spent in Hawai‘i, the risk of being food insecure decreased by 7%. A study done among legal immigrants in Illinois, California and Texas found no association between being 10 years or less in the U.S. and food insecurity (20). On the contrary, a study done among West African refugees found that time lived in the U.S. had a significant positive impact on food security (22). Some studies have also reported language barriers as a significant predictor of food insecurity (19-22). It is important to

² Retail points are equivalent to cash when used in any of the on campus dining services

point out that UHM has a high recruitment of international students, mainly Asians (90). We can only speculate that language barrier, lack of awareness of affordable grocery shopping sites, and lack of transportation may contribute to UHM students' food insecurity.

We found disparity in food security between Japanese and other ethnic groups. Native Hawaiians and Pacific Islanders, Filipinos and students with multiple ethnicities were more likely to be food insecure than Japanese students, after controlling for gender, having children, and marital status. Similar findings were found in the HHS (16), as well and in another local survey (33). Furthermore, a report from the Hawai'i Food Bank (2006) reveals that 33% of the people they serve are Native Hawaiian or other Pacific Islanders, 29% are Caucasian, and 22% are Asian (which includes Filipinos) (91). Hawaiians and Pacific Islanders appear to be the most food insecure in both the HHS and in the local survey. Their results agree with our findings. Actually, being Native Hawaiian and Pacific Islander was the most significant predictor for food insecurity in the current study, increasing the risk of being food insecure 11 times. However, these results have to be interpreted cautiously since the sample included only 15 Native Hawaiians and Pacific Islanders.

Conclusions

Food insecurity was prevalent among the UHM students surveyed. One in every five students surveyed was food insecure and almost half of the students experienced some kind of food insecurity. Social determinants of food insecurity were being Native

Hawaiians/Pacific Islanders, Filipinos, or having two or more ethnicities, reporting living on campus or off-campus with roommates, and having a shorter residency in Hawai'i.

Recommendations

There is a need to increase awareness about the magnitude of such a serious public health problem on UHM campus, and about the characteristics of the students experiencing food insecurity. Immediate interventions are needed to ensure decreasing the impact of food insecurity on the educational process and scholastic achievement. Interventions to increase food availability and affordability on campus should be developed, and a map with local affordable groceries and ethnic stores should be provided for new coming students. Food availability and accessibility could be enhanced by having campus food banks, on-campus school gardens, and cooking classes. Additionally, criteria for getting financial aid should be reassessed. All information should be made available via a student website.

Future studies should focus on investigating if the type of school meal plan the student chooses is associated with food insecurity among UHM students. Our study failed to find an association between school meal plan and food insecurity, but our sample size for students participating in a school meal plan was only 29. The impact of food insecurity on academic success should also be studied. Moreover, studies measuring food insecurity at other U.S. campuses should be carried out to identify if this is a local phenomenon or a broader public health problem affecting students across the nation.

CHAPTER 4

SPENDING PATTERNS AS A PREDICTOR OF FOOD INSECURITY AMONG COLLEGE STUDENTS AT THE UNIVERSITY OF HAWAI'I AT MĀNOA (UHM)

Food insecurity is the inability to acquire adequate nutritious foods and is a condition resulting from financial resource constraint (2). However, there are factors other than income that affect household food security status. Examples of these factors include unexpected job loss, high food and housing costs (2), and marginal skills in managing personal finances (4). Objectives of this study were: 1) to describe UHM students' spending patterns and 2) to test the impact of UHM students' spending patterns on their food security status. We hypothesized that: 1) there is a difference in the amount of money spent in groceries between food secure and insecure students, and 2) there is a difference in the amount of money spent on discretionary items, such as cell phone, shopping and entertainment between the food secure and insecure. Detected differences would help to explain food insecurity and warrant interventions to improve personal financial skills and better approaches to manage resources.

Results

The percent of money spent in each spending category was calculated and expressed by food security status (Figure 4.1). Regardless of students' food security status, it is clear that most of surveyed students' expenditure was devoted to housing (48-53%), followed

by groceries (11-14%). Cell phone was the lowest expenditure item. Food secure students allocated a higher percent of their money to transportation, entertainment and shopping compared to low and very low food secure students, whose major costs were housing, groceries, and cell phone. These trends, however, were not statistically different (Appendix F).

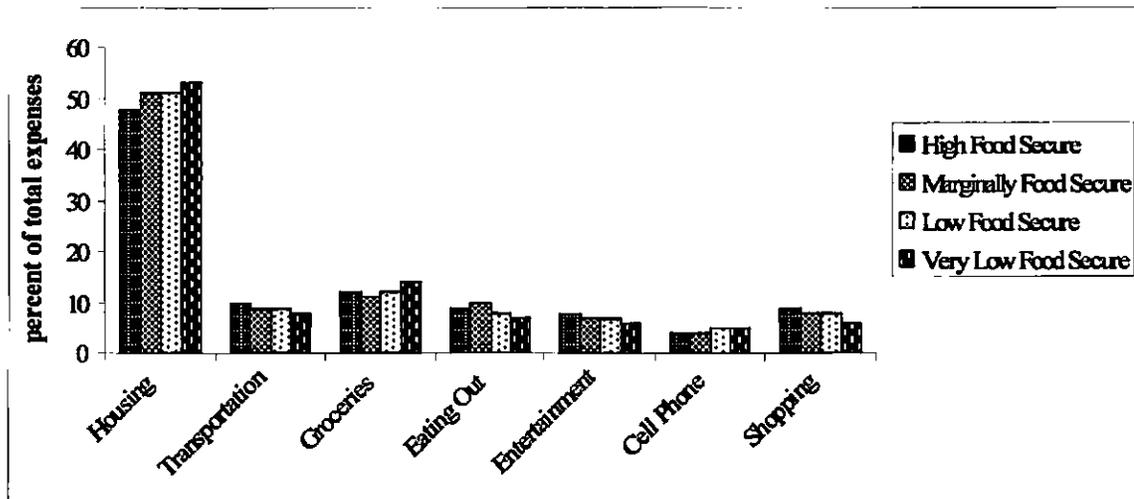


Figure 4.1. Percent of money allocated by students in each spending category by food security status

More than half of the students spent monthly between \$0-500 on housing (55%), \$0-100 on transportation (63%), \$0- 150 on groceries (68%), \$0-100 eating out (59%), \$0-50 on entertainment (50%), \$0-60 on cell phone (76%), and \$0-100 shopping (71%) (Table 4.1). The proportion of food secure to food insecure students significantly increased with increase expenditure on eating out, entertainment, and shopping.

Table 4.1. Distribution of the monthly spending pattern among the food secure and food insecure students¹

	Total n (%)	Food Secure n (%)	Food Insecure n (%)	p-value²
Housing				
\$0-500	176 (55)	138 (54)	38 (58)	0.27
\$501-750	74 (23)	58 (22)	16 (24)	
\$751-1000	27 (8)	20 (8)	7 (11)	
>\$1000	46 (14)	41 (16)	5 (7)	
Transportation				
\$0-50	120 (37)	89 (35)	31 (47)	0.135
\$51-100	83 (26)	69 (27)	14 (21)	
\$101-150	44 (14)	35 (13)	9 (14)	
\$151-200	27 (8)	23 (9)	4 (6)	
>\$200	49 (15)	41 (16)	8 (12)	
Groceries				
\$0-50	75 (23)	63 (24)	12 (18)	0.735
\$51-100	83 (26)	60 (23)	23 (35)	
\$101-150	60 (19)	48 (19)	12 (18)	
\$151-200	43 (13)	35 (14)	8 (12)	
>\$200	62 (19)	51 (20)	11 (17)	
Eating Out				
\$0-50	86 (26)	62 (24)	24 (36)	0.002
\$51-100	106 (33)	81 (31)	25 (38)	
\$101-150	73 (23)	61 (24)	12 (18)	
\$151-200	26 (8)	23 (9)	3 (5)	
>\$200	32 (10)	30 (12)	2 (3)	
Entertainment				
\$0-50	162 (50)	122 (47)	40 (61)	0.035
\$51-100	97 (30)	81 (32)	16 (24)	
\$101-150	36 (11)	27 (11)	9 (14)	
\$151-200	16 (5)	16 (6)	0 (0)	
>\$200	12 (4)	11 (4)	1 (1)	
Cell Phone				
\$0-30	131 (41)	108 (42)	23 (35)	0.395
\$31-60	114 (35)	90 (35)	24 (36)	
\$61-90	48 (15)	34 (13)	14 (21)	
\$91-120	23 (7)	20 (8)	3 (5)	
>\$120	7 (2)	5 (2)	2 (3)	
Shopping				
\$0-50	133 (41)	98 (38)	35 (53)	0.027
\$51-100	96 (30)	77 (30)	19 (29)	
\$101-150	43 (13)	38 (15)	5 (7)	
\$151-200	22 (7)	19 (7)	3 (5)	
>\$200	29 (9)	25 (10)	4 (6)	

Table 4.1. (Continued) Distribution of the monthly spending pattern among the food secure and food insecure students¹

	Total n (%)	Food Secure n (%)	Food Insecure n (%)	<i>p</i> -value ²
One-time large expense³				
\$0-350	41 (13)	29 (11)	12 (18)	0.365
\$351-500	51 (16)	41 (16)	10 (15)	
\$501-750	52 (16)	44 (17)	8 (12)	
\$751-1000	45 (14)	34 (13)	11 (17)	
>\$1000	134 (41)	109 (43)	25 (38)	

¹ Total sample = 323; percentages represent column totals

² Linear-by-linear association test, *p*-value < 0.05 is statistically significant

³ One-time large expense in the past year (e.g., tuition, school books, travel)

Unadjusted odds ratios were calculated for the significant spending variables observed in Table 4.1, using the dichotomous food security variable (food security/food insecurity).

Results revealed that for every extra \$10 spent monthly on eating out, entertainment, and shopping, the odds of being food insecure decreased by 8%, 6%, and 5% respectively (Table 4.2).

Table 4.2. Unadjusted odds ratios for selected spending categories among food insecure versus food secure students¹

Outcome variable	OR	95%CI ²	<i>p</i> -value ³
Eating Out	0.92	0.88-0.97	0.003
Entertainment	0.94	0.88-0.99	0.037
Shopping	0.95	0.90-0.99	0.029

¹ Total sample = 323

² Unadjusted Odds Ratio

³ *p*-value <0.05 is statistically significant

A multivariate model was created to analyze the association between food insecurity, students' spending patterns, and living arrangement, adjusting for gender, marital status, having children, and ethnicity (Table 4.3). The amount of money spent eating out was still a significant predictor of food insecurity in this model, though its effect was reduced. An additional multivariate model was constructed to determine if the amount of money spent on food, including groceries and eating out, would have an impact on food insecurity. It was found that for every extra \$100 spent on food monthly, the odds of being food insecure decreased by 35% (OR=0.65, 95%CI 0.47-0.89, p -value=0.007) (Appendix G).

Discussion

The spending patterns observed among UHM student were different from predicted. We found no significant differences in the amount of money spent on groceries and the amount of money spent on discretionary items between the food secure and the food insecure. Moreover, food insecure students spent significantly less money eating out and on food combining groceries and eating out, when compared to the food secure. However, these patterns were similar to those found among the U.S. food insecure population. Nord *et al.* (15) reported that food insecure U.S. households generally spend less money on food (groceries + eating out) than the food secure households. Qualitative studies also revealed that food insecure individuals usually cut back on eating out because they consider it unnecessary (49).

Table 4.3. Multivariate logistic model predicting likelihood of being food insecure by spending patterns¹

Outcome variable	B	OR²	95% CI	p-value³
Intercept	-3.725			0.001
Gender				
Male (n= 137)	0.406	1.50	0.81-2.78	0.197
Female (n=180)	0*	1.00		
Marital Status				
Single (n=269)	0.195	1.22	0.36-4.13	0.755
Married (n=48)	0*	1.00		
Children				
Yes (n=32)	1.079	2.94	0.91-9.47	0.071
No (n=285)	0*	1.00		
Living arrangement				
On campus (n=37)	1.281	3.60	1.34-9.68	0.011
Off-campus undetermined (n=34)	1.043	2.84	0.91-8.86	0.073
Alone (n=31)	0.716	2.05	0.59-7.15	0.262
With roommates (n=55)	1.290	3.63	1.34-9.83	0.011
With spouse/partner (n=64)	0.019	1.02	0.30-3.43	0.976
With parents/relatives (n=96)	0*	1.00		
Ethnicity				
Chinese (n=35)	2.000	7.39	1.33-41.14	0.022
Filipino (n=33)	2.748	15.61	3.06-79.68	0.001
Korean (n=13)	1.840	6.30	0.75-53.09	0.091
Native Hawaiian and Pacific Islanders (n=14)	2.951	19.13	2.74-133.35	0.003
White (n=82)	2.029	7.61	1.64-35.27	0.010
Two or more ethnicities (n=54)	2.554	12.86	2.67-61.93	0.001
Other (n=22)	1.612	5.01	0.78-32.39	0.090
Japanese (n=64)	0*	1.00		
Spending Patterns (n=317)				
Eat Out	-0.075	0.93	0.87-0.99	0.030
Entertainment	-0.001	0.999	0.92-1.08	0.988
Shopping	-0.013	0.99	0.93-1.05	0.677

¹ Total sample = 317

² Adjusted for gender, marital status, having children, living arrangement, and ethnicity

³ p-value <0.05 is statistically significant

* Set to zero because this parameter is redundant (reference category)

Based on previous research, we expected that marginal financial management abilities and poor spending decisions would significantly predict food insecurity among UHM students³. Studies done among EFNEP participants (30,31) and rural low-income families (29,32) found lack of personal financial management skills to be a predictor of food insecurity. In Hawaii also Derrickson (33) found that food insecurity was associated with budgeting practices.

A nationwide study conducted among upper-class college students revealed that 32% of the sample reported they were not prepared to manage their money on campus when they were freshmen (34). Fifteen percent also reported that they would usually choose to go out and have fun rather than stay at home and save money. Additionally, 11% of the students reported frequently skipping meals (once to several times a week) due to poor money management, and 31% reported skipping meals for the same reason few times a year to once a month (34). Another study done among juniors and seniors at Virginia Polytechnic Institute and State University also showed that students do not know how to budget their financial resources effectively. This was based upon the fact that students spent more money than they made. Students living off-campus had more budgeting experience than those living on campus (92).

In terms of how UHM students in our sample allocated their money, our results indicated students spent between 48-53% of their total expense on housing, 11-14% on groceries,

³ It is important to mention that the University of Hawaii offers money management seminars as part of freshmen orientation. This orientation however is voluntary.

8-10% on transportation, 7-10% eating out, 6-9% on shopping, 6-8% on entertainment, and 4-5% on cell phone. In a study that compared college-age students and non-students, Paulin (93) found that students spent approximately 27% of their income on housing, 13% on groceries, 5% eating out, 11.5% on transportation, 6.5% on entertainment, 7% on apparel and services, 16% on education, 5% on travel and vacation, and 9% on health care, personal insurance, and others. Our results were comparable to the findings reported by Paulin, except for housing costs. There are several reasons for this difference. First, Paulin used data drawn from the 1996-1998 Consumer Expenditure Surveys, which is a representative national sample. Second, he calculated the percent of money allocated to each category based on income data. Additionally, he studied individuals aged 18 to 22 years, who were financially independent and have never been married, excluding individuals who live with their parents, relatives, spouses, or partners.

Another study conducted among college students at the Virginia Polytechnic Institute and State University found that 40% of the students' income went to food, 25% to housing and bills, 16% to shopping, 8% to car related expenses, and 4% to entertainment (92). These findings significantly differ from our results, but it is important to mention that study design and sample size were different. The study included only 32 students, half of whom lived off-campus and half lived on-campus. Additionally, a report from the Bureau Labor Statistics found that individuals under the age of 35 spent on average 34% on housing, 7% on groceries, 6% eating out, 10% on transportation, 5% on entertainment, 5% on apparel and services, and 33% on other expenditures (including health care/personal insurance) (94). Our results are comparable to previous reports except for

cost of housing. Housing expenses in Honolulu are double the national average (95). Moreover, a report by Aloha United Way (96) indicated that housing was the biggest expense for both single-parent families and two-parent families in Hawai'i, and accounted for approximately 37% of the living expenses cost.

College students in the U.S. spent on average \$287 a month on discretionary items during Spring 2002, and most of that money was spent on beverages and snack foods (97).

Discretionary items were defined as anything other than tuition, room/board, rent/mortgage, and books/school fees. Additionally, another study among college students indicated that their overall spending had increased 16% and discretionary spending had increased 24% since 2003 (98). In 2005, 85% of college students owned a cell phone, 25% planned to buy a digital camera in the coming year, and 17% an MP3 player (98).

Limitations

Income is a known contributing factor to food insecurity. Income data were not collected in this study; hence, we cannot determine the extent to which income contributes to food insecurity among UHM students. Moreover, when calculating the students' allocation of money to different spending categories, the sum of total expenses had to be used instead of income. Therefore, our results are not directly comparable to other studies that used income as the base for these calculations. In addition, possession and use of credit cards, as well as amount of debt due to credit card usage, was not assessed.

Conclusions

Spending patterns between food insecure and food secure UHM students do not differ significantly, except for the amount of money spent eating out and the amount of money spent on food (groceries + eating out). Since food insecure UHM students are spending less money on food than the food secure, we speculate that either the quality or the quantity (or both) of the food purchased was compromised among this population. One of the coping strategies of food insecure UHM students may include charging some expenses to their credit card(s). This could explain why we did not find differences in the non-food related spending patterns between the food secure and insecure UHM students.

Recommendations

Interventions are needed to enhance students' skills in managing their financial resources. These interventions could include a hands-on workshop or an online information site on money management.

More research is needed to develop a validated instrument to assess students' expenditures. Differences in quality and variety of food purchased by food secure and food insecure students at UHM need to be assessed. In addition, the coping strategies that UHM food insecure students use to deal with their food insecurity should be studied, including credit cards usage.

CHAPTER 5

DIETARY DETERMINANTS OF FOOD INSECURITY AMONG COLLEGE STUDENTS AT THE UNIVERSITY OF HAWAI'I AT MĀNOA (UHM)

Food insecurity is the inability to acquire adequate nutritious foods and has been previously associated with nutritional problems, including nutrient deficiencies (10,35,37,38,42-46) and decreased intake of certain food groups (10,36,39-42). One of the objectives of this study was to determine if food insecurity among UHM students affects their dietary intake. When compared to food secure UHM students, it is hypothesized that UHM students suffering from food insecurity, would consume fewer portions of vegetables, fruits, and meats. It is also hypothesized that food insecure UHM students would consume more portions of Saimin (ramen) soup, which is a local inexpensive food. The term “portions” used throughout this thesis refers to the examples of food amounts used on our survey for each food category (see Appendix A).

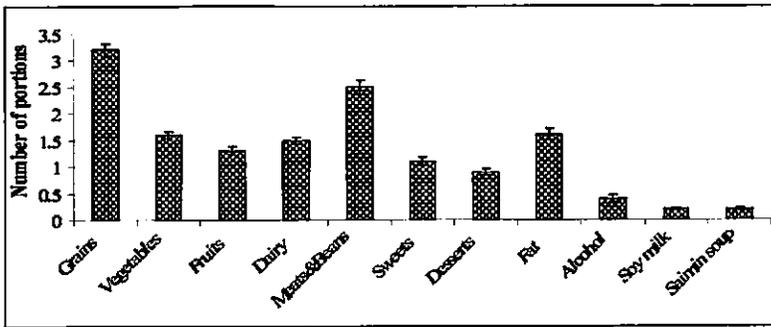
It is important to mention that the dietary question used to assess UHM students' food intake in this study has not been validated. The purpose of this dietary question was to get an overall picture of what students reported consuming. Therefore, the results from this section should be taken cautiously.

Results

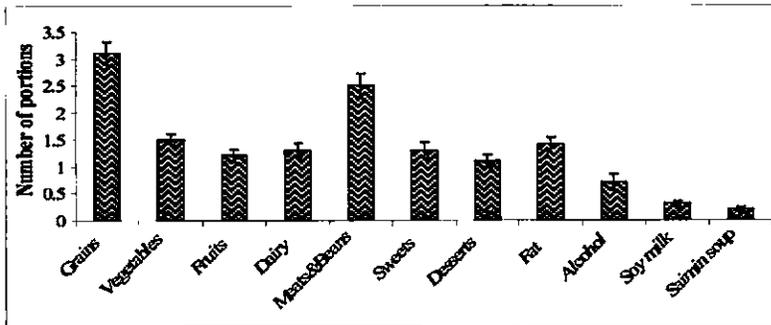
Figure 5.1 (a-d) shows the general food consumption pattern reported by food security level. Table 5.1 indicates that grains and fruits were the only categories that showed statistical significant difference at $p < 0.05$ in mean portions reported to be consumed. Low food secure students reported eating significantly fewer portions of grains than the other food security groups. Additionally, low food secure students reported eating significantly fewer portions of fruits when compared to the high food secure students. Although not statistically significant, data showed that food insecure students reported consuming less portions of vegetables, dairy, and meats and beans.

Students were asked if their reported dietary intake was less than usual, usual, or more than usual. Seventy four percent of the students reported that their reported intake was usual with 16% reporting less than usual and 10% reporting more than usual (Table 5.2). The percent of students describing their intake as usual was significantly higher among the food secure than insecure (Table 5.2). Unadjusted odds ratios revealed that students who reported that their previous-day intake was more than usual were 3 times more likely to be food insecure, when compared to those reporting their intake as usual (OR=2.95, 95% CI 1.42-6.16, $p = 0.004$) (Appendix H).

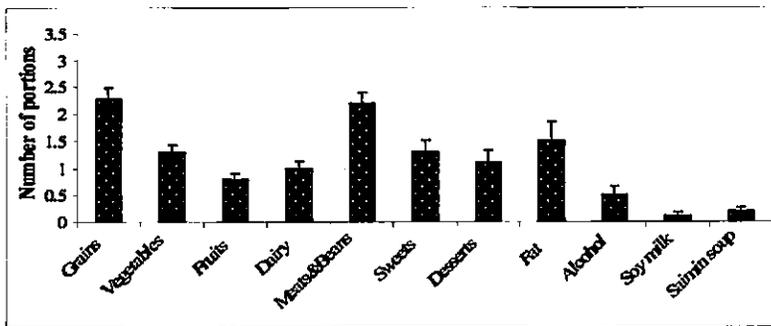
a. Food Secure



b. Marginally Food Secure



c. Low Food Secure



d. Very Low Food Secure

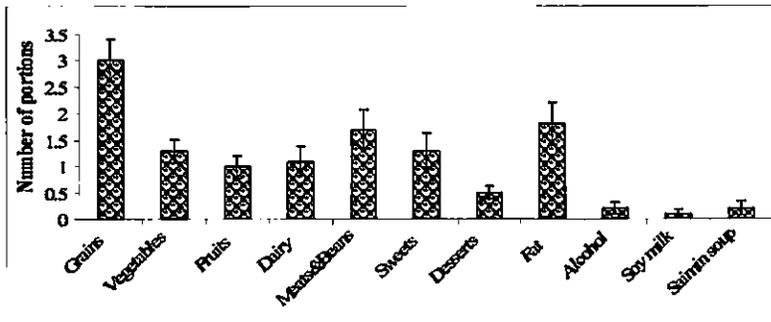


Figure 5.1. Pattern of reported food intake (mean ± SE) by students' food security status

Table 5.1. Mean number of portions of food categories by food security status¹

Food Groups	High Food Secure	Marginally Food Secure	Low Food Secure	Very Low Food Secure	Significance
Grains (oz-eq) Mean (SE)	3.2 (0.12) ^a	3.1 (0.22) ^a	2.3 (0.18) ^b	3.0 (0.40) ^a	<i>p</i> =0.003
Vegetables (cups) Mean (SE)	1.6 (0.07)	1.5 (0.10)	1.3 (0.12)	1.3 (0.22)	NS
Fruits (cups) Mean (SE)	1.3 (0.08) ^a	1.2 (0.13) ^{ab}	0.8 (0.11) ^b	1.0 (0.21) ^{ab}	<i>p</i> =0.038
Dairy (cups) Mean (SE)	1.5 (0.07)	1.3 (0.13)	1.0 (0.13)	1.1 (0.28)	<i>p</i> =0.064
Meats & Beans (oz-eq) Mean (SE)	2.5 (0.13)	2.5 (0.24)	2.2 (0.21)	1.7 (0.37)	NS
Sweets² Mean (SE)	1.1 (0.08)	1.3 (0.15)	1.3 (0.22)	1.3 (0.32)	NS
Desserts³ Mean (SE)	0.9 (0.06)	1.1 (0.12)	1.1 (0.21)	0.5 (0.13)	NS
Fat (tsp) Mean (SE)	1.6 (0.11)	1.4 (0.14)	1.5 (0.36)	1.8 (0.40)	NS
Alcohol⁴ Mean (SE)	0.4 (0.07)	0.7 (0.15)	0.5 (0.16)	0.2 (0.11)	NS
Soy milk (cups) Mean (SE)	0.2 (0.03)	0.3 (0.06)	0.1 (0.08)	0.1 (0.07)	NS
Salmon soup (package) Mean (SE)	0.2 (0.03)	0.2 (0.05)	0.2 (0.07)	0.2 (0.14)	NS

¹ Number of portions based on the My Pyramid cups and ounce-equivalents for the different food groups, total number of valid surveys = 395

² One portion of sweets is equal to 2 TBSP added white/brown sugar, 2 TBSP jelly, 2 TBSP honey, 4 pieces hard candy

³ One portion of desserts is equal to 1 candy bar, 4 small cookies, 4" by 4" by 2" of brownie, cake, or pie

⁴ One portion of alcohol is equal to 1 glass of wine, 1 oz of hard liquor, 12 oz beer

^{a,b} The values with different letters are significantly different from each other (Duncan's test)

Table 5.2. Reported amount of food eaten the day before the survey by food security status¹

	Total	High Food Secure	Marginally Food Secure	Low Food Secure	Very Low Food Secure	Significance
Amount of food eaten the day before the survey, n (%)						<i>0.007</i>
Less than usual	61 (16)	30 (14)	19 (21)	6 (11)	6 (30)	
Usual	275 (74)	166 (79)	62 (69)	35 (66)	12 (60)	
More than usual	37 (10)	14 (7)	9 (10)	12 (23)	2 (10)	

¹ Total number of valid surveys = 373; percentages represent column totals

Very few students reported meeting 100% or more of the MyPyramid recommended amounts of food for all food groups, regardless of their food security status (Figure 5.2). The fruit group had the highest percentage of students reporting meeting 100% or more of the recommended amounts, followed by the dairy group. On the other hand, vegetable consumption was reduced gradually with the increased level of food insecurity.

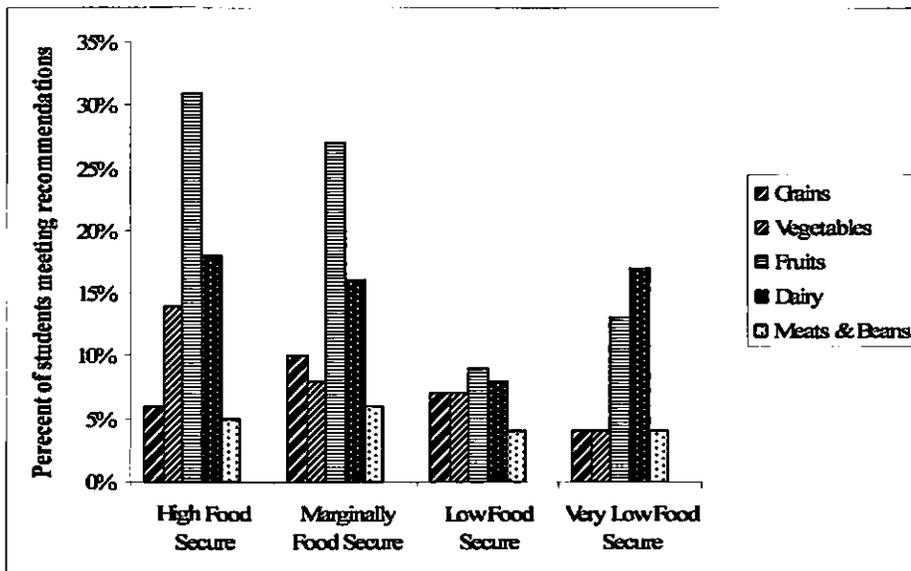


Figure 5.2. Percent of students who reported meeting 100% or more of the MyPyramid recommendations for each food group by food security status

Table 5.3 shows the percent of the MyPyramid recommended amounts of food attained. Seventy seven percent of the students reported meeting less than 50% of the recommended amounts for meat. Moreover, around half of the students reported meeting less than 50% of the recommendations for grains (60%), dairy (59%), vegetables (54%), and fruits (45%). Chi-square analyses done by dichotomizing the food security variable revealed that food insecurity was associated with low percent of students reporting meeting 100% of the MyPyramid recommended amounts for grains ($p=0.0003$), fruits ($p=0.003$), and dairy ($p=0.009$).

Discussion

Low food secure UHM students reported consuming significantly fewer portions of grains (0.9 oz-equivalents) and fruits (0.5 cups) when compared with the high food secure students. Although not significant, reporting low vegetable and meat consumption was reported among the low and very low food secure, when compared to the high food secure. We hypothesized that food insecurity was accompanied with high consumption of saimin/ramen soup; however, results showed that consumption of saimin was not significantly different between the food secure and insecure.

Table 5.3. Distribution of students' reported food intake compared to MyPyramid recommendations for each food group, by food security status¹

	Total N (%)	High Food Secure N (%)	Marginally Food Secure N (%)	Low Food Secure N (%)	Very Low Food Secure N (%)
% of Recommendation Reported-Grains²					
<25%	78 (20)	32 (15)	16 (18)	23 (40)	7 (31)
25-49%	152 (40)	84 (40)	38 (43)	21 (37)	9 (39)
50-74%	91 (24)	65 (31)	17 (19)	5 (9)	4 (17)
75-99%	33 (9)	18 (8)	9 (10)	4 (7)	2 (9)
≥100%	26 (7)	12 (6)	9 (10)	4 (7)	1 (4)
% of Recommendation Reported-Vegetables					
<25%	59 (16)	28 (14)	13 (15)	11 (20)	7 (29)
25-49%	140 (38)	72 (35)	37 (44)	23 (43)	8 (34)
50-74%	91 (25)	57 (28)	18 (21)	10 (19)	6 (25)
75-99%	39 (10)	21 (10)	10 (12)	6 (11)	2 (8)
≥100%	40 (11)	28 (14)	7 (8)	4 (7)	1 (4)
% of Recommendation Reported-Fruits					
<25%	118 (32)	59 (29)	29 (35)	22 (42)	8 (33)
25-49%	46 (13)	18 (9)	12 (14)	10 (19)	6 (25)
50-74%	86 (24)	48 (24)	18 (22)	15 (28)	5 (21)
75-99%	19 (5)	14 (7)	2 (2)	1 (2)	2 (8)
≥100%	93 (26)	62 (31)	23 (27)	5 (9)	3 (13)
% of Recommendation Reported-Dairy³					
<25%	71 (19)	33 (16)	15 (17)	14 (26)	9 (37)
25-49%	148 (40)	76 (37)	37 (42)	27 (51)	8 (33)
50-74%	92 (25)	59 (28)	22 (25)	8 (15)	3 (13)
75-99%	2 (1)	2 (1)	0 (0)	0 (0)	0 (0)
≥100%	60 (16)	38 (18)	14 (16)	4 (8)	4 (17)
% of Recommendation Reported-Meats & Beans					
<25%	126 (34)	63 (31)	29 (33)	21 (37)	13 (57)
25-49%	160 (43)	91 (45)	37 (42)	26 (46)	6 (26)
50-74%	53 (14)	31 (15)	14 (16)	5 (9)	3 (13)
75-99%	14 (4)	9 (4)	3 (3)	2 (4)	0 (0)
≥100%	18 (5)	10 (5)	5 (6)	2 (4)	1 (4)

¹ Percentages represent column totals

² Includes saimin/ramen soup

³ Includes soy milk

Previous studies showed that food insecurity was associated with decreased intake of fruits (10,35,39,40,42), vegetables (10,35,39,40), dairy products (10,42), meats (40), and refined grains (42). Unlike our results, Derrickson and Anderson (41) reported an increase intake of saimin/ramen soup among food insecure individuals in Hawai'i. All these studies, however, studied different populations than the one in this study (non-students).

When comparing reported consumed portions of each food group with the MyPyramid recommendations, our data clearly indicated that almost no students reported meeting their recommended amount of food for each food group, regardless of their food security status. Few studies have looked at compliance of college students to dietary recommendations. Most of them used convenience samples and undergraduate students only, and compared students' diet to the Food Guide Pyramid. However, all of the previous studies concurred with our findings of few students reporting reaching 100% or more of the recommendations for all food groups (99-103). In a previous study done among UHM students for the National College Health Assessment (NCHA) in 2004 (104), only 4.8% of the students reported eating 5 servings or more of fruits and vegetables daily. Similarly, results from the U.S. NCHA study⁴ indicated that only 7% of the students reported eating 5 or more serving of fruits and vegetables per day (105). Cotugna and Vickery (103) found that only 16% of the University of Delaware's students sampled reported meeting the minimum recommendations for grains, and the highest reported compliance was for the fruit group (56% of the students got the minimum

⁴ Pooled data from colleges all over the nation, including UHM

recommended number of servings). DiGiacchino *et al.* (102) found that only 6.9% of their sample, students at University of North Carolina at Charlotte, reported consuming 6 servings of grains, but unlike our study, 59% of students reported meeting the recommendations for the meat group (highest compliance). Similarly, Haberman and Luffey (101) found that more than 80% of their student sample from University of Pittsburgh reported eating insufficient amounts of grains, fruits and vegetables, and dairy products. Anding *et al.* (100) reported that, on average, a sample of students from University of Houston reported meeting the minimum recommendations for the meat group, but fell short on all the other food categories.

Mooney and Walbourn (106) found that the most common food rejected by female college students in their study at St. Lawrence University was meat, while males most commonly rejected vegetables. Females avoided meat mostly because of ethical reasons, while males avoided vegetables mostly because of taste. Some other reasons included lack of time and therefore, preference for convenient foods.

Limitations

Although our results are comparable to many published studies in and outside of Hawai'i, underestimation of food consumed may be an explanation for these findings. The dietary questionnaire used in the study has not been validated, and was based on self-reports using 11 questions about portions of each food group consumed in the last 24 hours. Though 74% of students described their reported intake as usual, the low food consumption could be interpreted as inaccurate estimation of amount of food consumed

due to participants' inability to distinguish serving sizes (107-110). A study done by the USDA compared people's actual intake (using a 14-day food diaries) with people's perception of what they usually consume in an average day (111). The results indicated that participants in the study (both females and males, across age groups) underestimated how many portions of grains, fats, oils, and sweets they consumed, and overestimated their consumption of fruits, vegetables, milk products, and meat. The only exception was that adult males reported their vegetable intake to be slightly lower than what it actually was. Another study conducted among adults found that data collected with self-reported dietary instruments (i.e., food frequency questionnaires and 24-hour dietary recalls) underreported energy intake by 12 to 38% and protein intake by 11 to 34%, when compared to valid biomarkers (112). Furthermore, vegetable intake is sometimes underreported by Asians because vegetables are commonly found in mixed dishes in Asian foods (113).

In the future, more detailed and accurate food intake should be collected and validated among UHM students. This should be done with either biomarkers or pictures of food or food models. Errors in reporting food consumption likely occurred with a number of the food categories, especially grains. We expect however that these errors would have happened across all food security groups. Therefore, we cannot completely ignore the association between food intake and food insecurity.

Conclusions

Food insecurity in this study may be associated with a decreased reported intake of grains, fruits, and dairy among UHM students. In addition, the majority of the students in the sample, irrespective of their food security status, did not report meeting MyPyramid's amounts of food recommended for each food group.

Recommendations

Inadequate food intake could translate into nutrient deficiencies and subsequently health problems, affecting students' performance. Future studies also should focus on analyzing the association between UHM students' nutrient intake and food insecurity; specifically, the impact of individual nutrient deficiencies on school performance, such as iron deficiency and its impact on energy, absenteeism, and scholastic achievement. More research is also needed to validate the use of food frequency questionnaires and 24 hour recalls among this special population.

CHAPTER 6

IMPACT OF FOOD INSECURITY ON BODY IMAGE, LIFESTYLE, AND HEALTH STATUS AMONG COLLEGE STUDENTS AT THE UNIVERSITY OF HAWAI'I AT MĀNOA (UHM)

Previous studies have shown that food insecurity is associated with reporting having a poor health, as well as being overweight and obese. Objectives of this study were to determine if food insecurity among UHM students is associated with: 1) overweight and obesity and/or 2) reporting having a poor health status, concentration level, and energy level. We hypothesized that food insecure students would be: 1) more likely to be overweight and obese, and 2) more likely to report poor health, concentration, and energy levels.

Results

Lifestyle Characteristics

Seven percent of participating students were classified as obese, 24% as overweight, 63% as normal, and 6% as underweight (Table 6.1). Ten percent reported being on a weight loss diet, while 3% reported consuming no animal flesh. Additionally, 41% of students reported consuming vitamins and/or minerals dietary supplements and 79% exercised daily. The majority of the students (57%) used a car as their main mode of transportation. None of these variables showed statistical difference except for exercise, where the very low food secure seemed to exercise more than the other groups (Table 6.1).

Table 6.1. Distribution of students' lifestyle determinants by food security status¹

Lifestyle Determinants	Total	High Food Secure	Marginally Food Secure	Low Food Secure	Very Low Food Secure	Significance
BMI Categories (Kg/m²), n (%)						*
Underweight (< 18.5)	17 (6)	8 (5)	7 (9)	2 (5)	0 (0)	
Normal (18.5 - 24.9)	202 (63)	117 (65)	47 (58)	25 (61)	13 (76)	
Overweight (25 - 29.9)	77 (24)	40 (22)	22 (27)	11 (27)	4 (24)	
Obese (≥ 30)	23 (7)	15 (8)	5 (6)	3 (7)	0 (0)	
On a Weight Loss Diet, n (%)						NS
Yes	38 (10)	20 (9)	12 (12)	4 (7)	2 (8)	
No	362 (90)	198 (91)	85 (88)	56 (93)	23 (92)	
Vegetarian², n (%)						**
Yes	12 (3)	7 (3)	4 (4)	0 (0)	1 (4)	
No	394 (97)	215 (97)	94 (96)	60 (100)	25 (96)	
Consume Dietary Supplements, n (%)						NS
Yes	166 (41)	93 (42)	41 (42)	19 (32)	13 (50)	
No	238 (59)	127 (58)	57 (58)	41 (68)	13 (50)	
Exercise, n (%)						<i>p=0.047</i>
Yes	321 (79)	183 (82)	70 (71)	45 (74)	23 (88)	
No	87 (21)	39 (18)	29 (29)	16 (26)	3 (12)	
Mode of transportation, n (%)						*
Bike	20 (5)	7 (3)	7 (7)	3 (5)	3 (11)	
Bus	40 (10)	20 (9)	12 (12)	7 (12)	1 (4)	
Car	231 (57)	151 (69)	47 (49)	24 (40)	9 (35)	
Walk	51 (13)	16 (7)	18 (19)	15 (25)	2 (8)	
Multiple	46 (11)	20 (9)	10 (10)	10 (17)	6 (23)	
Other	16 (4)	7 (3)	3 (3)	1 (1)	5 (19)	

¹ Total number of valid surveys = 408. Numbers may vary because of missing data; percentages represent column totals.

² Indicated that they consumed no animal flesh

* Chi-square analyses with four food security categories were not performed due to small sample size in each cell

** Sample size too small to analyze differences

Since more than 20% of the expected cell values for mode of transportation and for the BMI categories variable were less than five, chi-square analyses with the four food security categories were not performed. When food security was dichotomized as food security and food insecurity, there was no association between food security and BMI ($p=0.909$), but there was an association between food insecurity and mode of transportation ($p=0.002$).

Unadjusted odds ratios were calculated for exercise and mode of transportation using the dichotomous food security variable. In this bivariate analysis, exercise was not significantly associated with food insecurity. When compared to walking, driving a car was significantly negatively associated with food insecurity (OR=0.33, 95% CI 0.17-0.66, $p =0.002$) (Appendix J).

Tables 6.2 and 6.3 show the students' calculated BMI against their body images, for food secure and food insecure students respectively. Thirty five percent of the food secure and 40% of the food insecure had a distorted body image (e.g., student was underweight and perceived him or herself as normal weight, or student had normal weight and perceived him or herself as underweight or overweight, etc.). This difference between the food secure and insecure was not statistically significant (Appendix K).

Table 6.2. Food secure students' body image compared to their actual BMI¹

Actual BMI	Body perception, n (%)			
	Underweight	Normal Weight	Overweight	Obese
Underweight ²	5 (33)	10 (77)	0 (0)	0 (0)
Normal Weight ³	11 (7)	128 (77)	25 (15)	1 (1)
Overweight ⁴	0 (0)	27 (44)	34 (56)	0 (0)
Obese ⁵	0 (0)	0 (0)	17 (85)	3 (15)

¹ Total sample = 260; shading indicates students that do not have a distorted body image

² BMI < 18.5 Kg/m²

³ BMI = 18.5-24.9 Kg/m²

⁴ BMI = 25-29.9 Kg/m²

⁵ BMI ≥ 30 Kg/m²

Table 6.3. Food insecure students' body image compared to their actual BMI¹

Actual BMI	Body perception, n (%)			
	Underweight	Normal Weight	Overweight	Obese
Underweight ²	0 (0)	1 (100)	0 (0)	0 (0)
Normal Weight ³	5 (14)	26 (70)	6 (16)	0 (0)
Overweight ⁴	0 (0)	8 (53)	7 (47)	0 (0)
Obese ⁵	0 (0)	1 (33)	2 (67)	0 (0)

¹ Total sample = 57; shading indicates students that do not have a distorted body image

² BMI < 18.5 Kg/m²

³ BMI = 18.5-24.9 Kg/m²

⁴ BMI = 25-29.9 Kg/m²

⁵ BMI ≥ 30 Kg/m²

Regardless of food security status, the majority of underweight students who perceived themselves as normal and those with normal weight who perceived themselves as overweight or obese were females (Appendix K). Conversely, the majority of the students who perceived themselves as underweight when they were normal, or perceived themselves as normal when they were overweight or obese were males (Appendix K). No specific patterns were observed by ethnicity.

Health Determinants

Students' self-reported health status, concentration level, and energy level are shown in Table 6.4. Overall, 29%, 40% and 41% of the students reported having a fair, poor, or very poor health status, concentration level, and energy level respectively. The percent of students reporting having a good or very good health status, concentration, and energy level was significantly higher among the food secure.

Table 6.4. Distribution of students' health determinants by food security status¹

Health Determinants	Total	High Food Secure	Marginally Food Secure	Low Food Secure	Very Low Food Secure	Significance
Self-reported Health Status, n (%)						<i>p=0.001</i>
Good or Very good	289 (71)	173 (78)	69 (70)	31 (52)	16 (62)	
Fair, Poor, or Very poor	117 (29)	49 (22)	29 (30)	29 (48)	10 (38)	
Concentration level, n (%)						<i>p=0.000</i>
Good or Very good	244 (60)	162 (73)	42 (43)	25 (42)	15 (58)	
Fair, Poor, or Very poor	161 (40)	60 (27)	55 (57)	35 (58)	11 (42)	
Energy level, n (%)						<i>p=0.000</i>
Good or Very good	237 (59)	153 (69)	48 (49)	24 (40)	12 (46)	
Fair, Poor, or Very poor	168 (41)	69 (31)	49 (51)	36 (60)	14 (54)	

¹ Total number of valid surveys = 408. Numbers may vary because of missing data; percentages represent column totals.

When using the food security dichotomous variable (food security/food insecurity), self-reported health status, concentration level, and energy level were still positively associated with food security (Figures 6.1, 6.2, and 6.3 respectively).

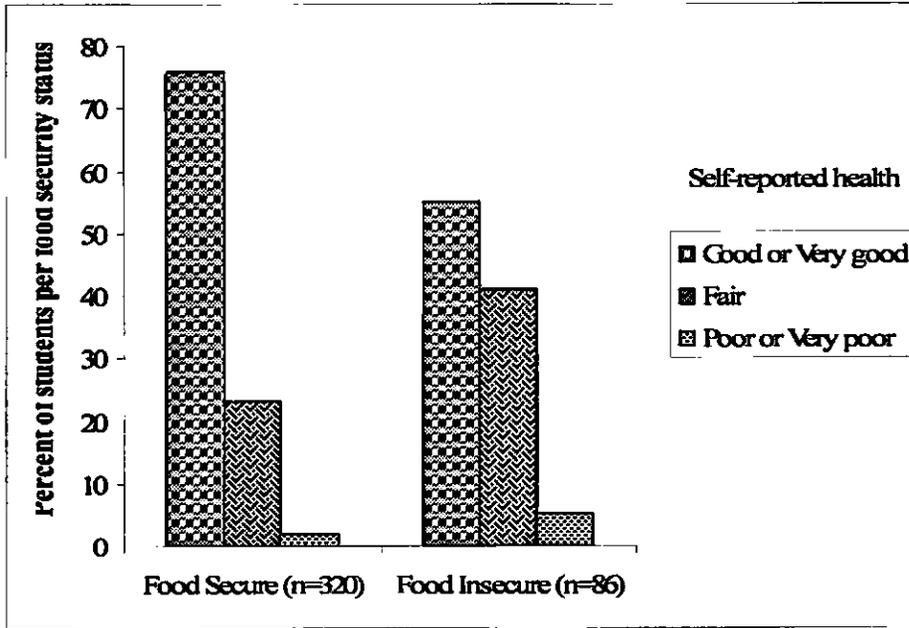


Figure 6.1. Distribution of students' self-reported health by food security status

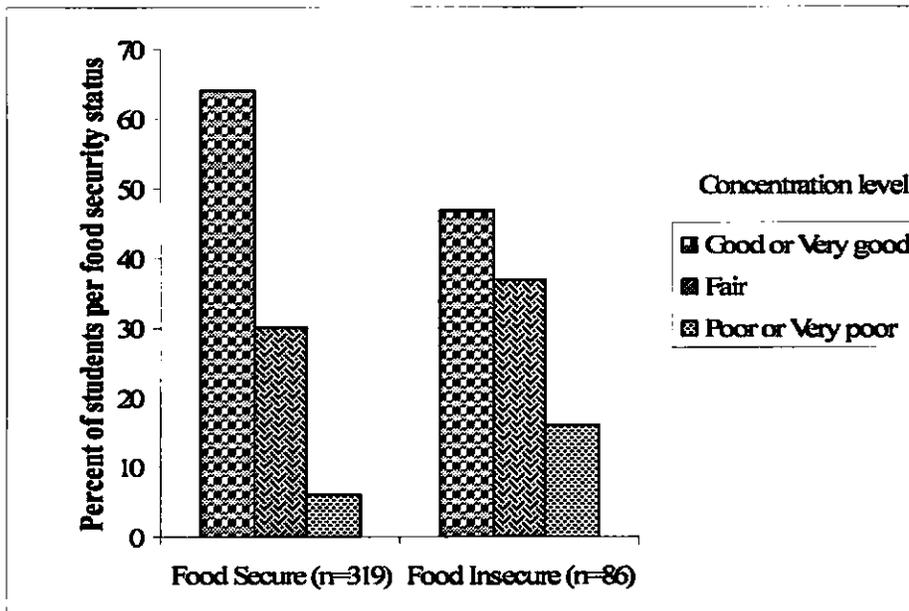


Figure 6.2. Distribution of students' self-reported concentration level by food security status

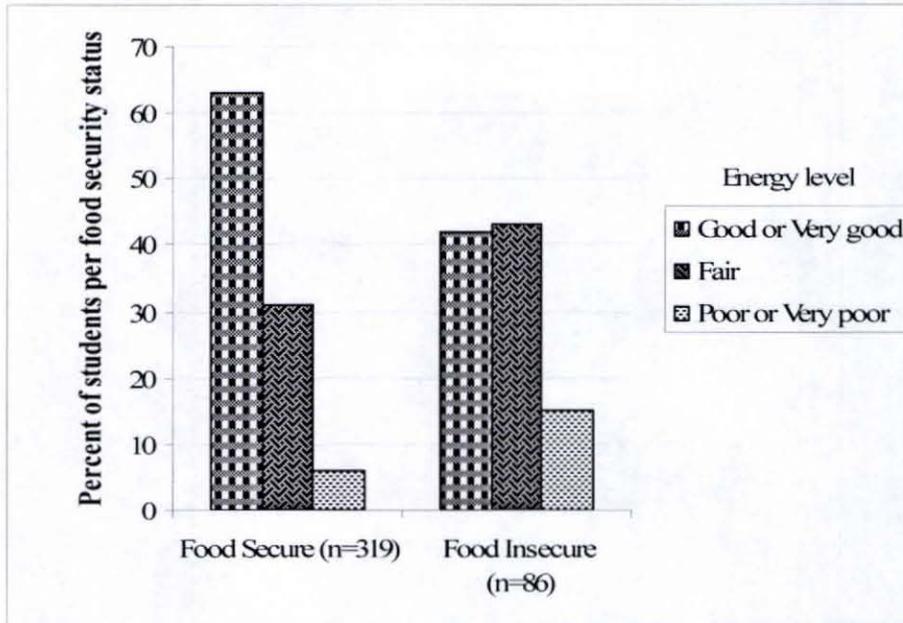


Figure 6.3. Distribution of students' self-reported energy level by food security status

In bivariate analysis, food insecure students were 2.58 times more likely to report having a fair, poor, or very poor health status, when compared to the food secure (Table 6.5).

Similar results were observed for concentration and energy level. Food insecure students were 2.04 times and 2.37 times more likely to report having a fair/poor/very poor concentration and energy level, respectively, when compared to their food secure counterparts.

Table 6.5. Odds of reporting having a fair, poor, or very poor health status, concentration, and energy level by food security status

	Fair/Poor/Very Poor Self-reported Health			Fair/Poor/Very Poor Concentration Level			Fair/Poor/Very Poor Energy Level		
	OR ¹	95% CI	<i>p</i> -value ²	OR ¹	95% CI	<i>p</i> -value ²	OR ¹	95% CI	<i>p</i> -value ²
Food Insecure	2.58	1.57-4.22	0.000	2.04	1.26-3.3	0.004	2.37	1.46-3.84	0.001
Food Secure	1.00*			1.00*			1.00*		

¹ Unadjusted Odds Ratio

² *p*-value <0.05 is statistically significant

* Reference category

A multivariate logistic regression model was performed to analyze the relationship between reporting having a fair, poor, or very poor health status and being food insecure, while controlling for gender, marital status, and having children (Table 6.6). In this multivariate model, food insecurity was still a significant predictor of reporting having a poor health.

Table 6.7 shows the results of a multivariate model in which the association between reporting having a fair/poor/very poor concentration level and food insecurity was studied, while adjusting for gender, marital status, and having children. Food insecure students were 1.9 times more likely to report having a fair, poor, or very poor concentration level, when compared to the food secure. This effect was somewhat attenuated when compared to results from bivariate analyses.

Table 6.6. Multivariate logistic model predicting likelihood of reporting having a fair, poor, or very poor health status by food security¹

Outcome variable	B	OR ²	95% CI	p-value ³
Intercept	-2.546			0.000
Food Security Status				
Food Insecure (n=82)	0.935	2.55	1.51-4.30	0.000
Food Secure (n=310)	0*	1		
Gender				
Male (n=167)	-0.418	0.66	0.41-1.05	0.082
Female (n=225)	0*	1		
Marital Status				
Single (n=337)	1.676	5.34	1.84-15.50	0.002
Married (n=55)	0*	1		
Children				
Yes (n=39)	0.954	2.60	0.96-6.99	0.060
No (n=353)	0*	1		

¹ Total sample = 392

² Adjusted for gender, marital status, and having children

³ p-value <0.05 is statistically significant

* Set to zero because this parameter is redundant (reference category)

Table 6.7. Multivariate logistic model predicting likelihood of reporting having a fair, poor, or very poor concentration level by food security¹

Outcome variable	B	OR ²	95% CI	p-value ³
Intercept	-1.618			0.000
Food Security Status				
Food Insecure (n=82)	0.643	1.9	1.15-3.14	0.012
Food Secure (n=309)	0*	1.00		
Gender				
Male (n=167)	-0.129	0.88	0.58-1.34	0.551
Female (n=224)	0*	1.00		
Marital Status				
Single (n=336)	1.163	3.20	1.40-7.34	0.006
Married (n=55)	0*	1.00		
Children				
Yes (n=39)	0.855	2.35	0.97-5.69	0.058
No (n=352)	0*	1.00		

¹ Total sample = 391

² Adjusted for gender, marital status, and having children

³ p-value <0.05 is statistically significant

* Set to zero because this parameter is redundant (reference category)

Similarly, a multivariate model was created to study the association between energy level and food insecurity, while controlling for gender, marital status, having children, and dietary intake (Table 6.8). Food insecure students were twice as likely to report having a fair, poor, or very poor energy level as food secure students were.

Table 6.8. Multivariate logistic model predicting likelihood of reporting having a fair, poor, or very poor energy level by food security¹

Outcome variable	B	OR ²	95% CI	p-value ³
Intercept	-1.416			0.001
Food Security Status				
Food Insecure (n=82)	0.788	2.20	1.32-3.65	0.002
Food Secure (n=309)	0*	1.00		
Gender				
Male (n=167)	-0.439	0.64	0.42-0.99	0.043
Female (n=224)	0*	1.00		
Marital Status				
Single (n=336)	1.121	3.07	1.35-6.99	0.008
Married (n=55)	0*	1.00		
Children				
Yes (n=39)	0.845	2.33	0.96-5.65	0.061
No (n=352)	0*	1.00		

¹ Total sample = 391

² Adjusted for gender, marital status, and having children

³ p-value <0.05 is statistically significant

* Set to zero because this parameter is redundant (reference category)

Discussion

Lifestyle Characteristics

Based on BMI, the body composition results of our student population are similar to those found in a previous study done among University of Hawai‘i at Mānoa (UHM) students for the National College Health Assessment (NCHA) in 2004 (104). Also, our

results are comparable to those found from pooled data from colleges across the nation (including UHM), for the year 2005 (105).

Being overweight or obese was not associated with food insecurity in our sample, opposite to previously reported findings among adults (16,37,50-52,54-58,114). Given that most of these studies have found BMI to be associated with food insecurity only among women, separate analyses were conducted by gender. These analyses revealed no association between food insecurity and overweight or obesity among women, nor among men (Appendix L).

Inconsistency in results between previously published studies and the current study could be explained by using different food security instruments. In this study, we used the Household Food Security Survey Module (HFSSM) to measure food insecurity. However, most of the studies analyzing the relationship between BMI and food insecurity among adults have not measured food insecurity with the HFSSM. Some studies have used the Radimer/Cornell hunger and food insecurity items (52,114), others have used an adaptation of the HFSSM (16,54,55), and others used the food insufficiency indicator (57,58). The studies that have used the HFSSM to measure the association between BMI and food insecurity have focused on Latino mothers (56) or have used NHANES data (37,50,51). These two samples (Latinos and NHANES) are not comparable to our primarily Asian population, and that could explain the difference in our results. Also, the impact of food insecurity on BMI could take time to develop (61), and therefore not readily seen in our relatively young population.

Seventy nine percent of our sample reported exercising daily. In the survey done at UHM for the NCHA, 69.4% of students reported doing some exercise in the previous week (104). Exercise in this study was found to be significantly associated with food security status. However, this significant association disappeared when bivariate analyses were performed. Similarly, Casey *et al.* (42) reported no association between exercise and food insufficiency among children 0-17 years old.

A relatively high percent of students in this study had a distorted body image and this was observed among both the food secure and the food insecure. The data also indicated that there is a gender difference: females tended to perceive themselves as larger than they actually were and males perceived themselves as smaller than they actually were. These body image gender differences are supported by other studies (115,116) including a study done among 22 different countries (117). Two studies focusing on African American college students reported that overweight males were less likely than overweight females to perceived themselves as such (118) and the majority of the overweight/obese students in their sample perceived themselves as normal (119).

Health Determinants

A considerable number of students in this study reported their health to be fair, poor, or very poor (29%). This was more than double the number of students who rated their health as fair or poor in the 2004 UHM NCHA survey (12.3%). In addition, 40% of the students in this study reported having a fair, poor, or very poor concentration level and 41% of the students reported having a fair, poor, or very poor energy level respectively.

Using multivariate analyses, food insecurity was significantly associated with sub-optimal health status, concentration level, and energy level among UHM students.

The impact of food insecurity on fair or poor health status have been previously reported among adults (16,30,64,65,69,71,120), children (66,67,70), and the elderly (45).

Similarly, studies have found food insecurity/insufficiency to have a negative impact on children's academic performance, such as lower arithmetic (59,78) and reading (59) scores. Additionally, Hamelin *et al.* (68) reports that the physical manifestations of food insecurity (i.e., fatigue, illness) could translate into a low concentration at school and low work capacity.

To our knowledge, no previous studies have looked at the association between energy level and food insecurity. Food insecure individuals may have a decreased food intake and therefore, be more likely to be nutrient deficient such as iron. This could in turn have a negative impact on the individuals' energy status.

Conclusions

Food insecurity in UHM students was significantly associated with decreased health status, as well as decreased concentration and energy levels. Having poor health, concentration, and/or energy levels may decrease students' work capability and scholastic achievement.

Recommendations

With the above conclusions in mind, there is an urgent need to develop and test interventions to increase awareness among UHM health center professionals regarding:

- 1) The prevalence of food insecurity among students,
- 2) The potential impact of food insecurity on health, and
- 3) The available referral resources where identified food insecure students or those at risk of being food insecure should be referred (e.g., Hawai'i Food Bank or the campus food bank if previously established).

Further research should focus on developing a student database that allows monitoring the prevalence and impact of food insecurity. In addition, a screening tool for early detection of students at risk should be developed and tested. Additionally, the impact of food insecurity on mental health and prevalence of depression among this population should be studied. Studies should be carried out to validate students self-reported health status to biological markers and to indicators of scholastic achievements, such as grades, years in school, and dropouts.

CHAPTER 7

SUMMARY AND CONCLUSIONS

Food insecurity “exists when there is limited or uncertain availability of nutritionally adequate and safe foods or limited or uncertain ability to acquire acceptable foods in socially acceptable ways.” (1) The goal of this study was to investigate food insecurity among college students at the University of Hawai‘i at Mānoa (UHM). The specific objectives were: 1) to determine the prevalence of food insecurity among UHM students; and 2) to determine the predictors and consequences of food insecurity among UHM students.

We hypothesized that the prevalence of food insecurity among UHM students would be higher than the prevalence observed for the state of Hawai‘i. Also, in terms of demographic predictors, we hypothesized that: 1) students living on campus, alone and/or with roommates would be more food insecure than those living with their parents or relatives, 2) students participating in a school meal plan would be more food insecure than those not participating, and 3) students identifying themselves as Native Hawaiians or Pacific Islanders would be the most food insecure.

For the spending patterns data, we hypothesized that: 1) there is a difference in the amount of money spent in groceries between food secure and insecure students, and 2)

there is a difference in the amount of money spent on discretionary items, such as cell phone, shopping and entertainment between the food secure and insecure.

In terms of dietary data, we hypothesized that, when compared to food secure UHM students, UHM students suffering from food insecurity, would consume fewer portions of vegetables, fruits, and meats. In addition, food insecure UHM students would consume more portions of saimin (ramen) soup, which is a local inexpensive food.

Finally, we hypothesized that food insecure students would be: 1) more likely to be overweight and obese, and 2) more likely to report poor health, concentration, and energy levels.

Summary of Major Findings

- Of the 408 UHM students surveyed, 21% were food insecure and 24% are at risk of being food insecure. The 21% prevalence is almost three times higher than the one observed for the state of Hawai'i for the years 2003-2005 (7.8%)
- Four percent of the students at UHM reported sometimes or often not having enough to eat (food insufficient)
- UHM students living on campus and off-campus with roommates were almost 4 times more likely to be food insecure when compared to those living with their parents or relatives
- Participating in a school meal plan was not significantly associated with food insecurity among UHM students

- The three ethnic groups most likely to be food insecure when compared to Japanese were Native Hawaiians and Pacific Islanders, Filipinos, and those with two or more ethnicities.
- For every year spent in Hawai'i, the odds of being food insecure among UHM student decreased by 7%.
- UHM food insecure students reported spending significantly less money eating out and on food, including groceries and eating out, when compared to UHM food secure students.
- There were no significant differences in the amount of money reported spent in discretionary items between UHM food secure and insecure students
- UHM food insecure students reported consuming fewer portions of grains, fruits, and dairy, when compared to food secure counterparts.
- The amount of saimin consumption reported was the same among the food secure and insecure students.
- A large number of UHM students, regardless of their food security status, did not meet 100% of the recommendations for any of the food groups.
- UHM food insecure students were 3.6 times more likely to report not meeting the recommendations for fruits, when compared to UHM food secure students.
- Based on BMI, being overweight and obese was not associated with food insecurity among UHM students.
- UHM food insecure students were twice as likely to report having a fair, poor, or very poor health status when compared to UHM food secure students.

- UHM food insecure students were 1.9 times more likely to report having a fair, poor, or very poor concentration level, when compared to the food secure.
- UHM food insecure students were twice as likely to report having a fair, poor, or very poor energy level, when compared to UHM food secure students.

Conclusions

The current study analyzed the prevalence of food insecurity in a college campus setting, identified characteristics of the food insecure students, and reported consequences of food insecurity on health status and food intake. The study also revealed an association between food insecurity and students' item expenditures.

Over 40% of UHM students surveyed experienced some type of food insecurity. Students at high risk of food insecurity were students identifying themselves as Native Hawaiians/Pacific Islanders, Filipinos and students with multiple ethnicities, those reporting living on campus and off-campus with roommates, and students with shorter residency in Hawai'i. Expenditure pattern on groceries, housing, entertainment, shopping, cell phone and transportation did not seem to predict food insecurity. However, spending \$10 extra per month on eating out was a good predictor of food security. Consequences of food insecurity among UHM students included reporting having a fair, poor, or very poor health status, concentration level, and/or energy level.

More studies measuring food insecurity on other US campuses are needed to identify if this is a local phenomenon because of the high living expenses in Hawai'i or a broader issue affecting students across the nation.

Implications

There is a need to increase awareness about the magnitude of this important public health issue on UHM campus, about the characteristics of the students experiencing food insecurity, and about the potential consequences of food insecurity among this population. Immediate interventions are needed to ensure decreasing the impact of food insecurity on the educational process and scholastic achievement.

Interventions to help students who are already suffering from food insecurity include:

- 1) Establishment of a campus food bank,**
- 2) Initiating campus community garden, and**
- 3) Enhancement of food availability and affordability on campus.**

Potential interventions to prevent food insecurity among UHM students include:

- 1) Creation of a database to monitor the prevalence and impact of food insecurity among UHM students,**
- 2) Development and testing of a screening tool for early detection of students at risk of food insecurity at the UHM health center,**
- 3) Development of a map with local affordable groceries and ethnic stores for new coming students,**

- 4) Offering elective cooking, basic nutrition, and money management courses, and
- 5) Reassessment of financial aid criteria.

Future studies among UHM students should focus on:

- 1) Assessing food security status of freshmen students. We hypothesize that food insecurity among UHM freshmen will be high because of lack of awareness of local food markets and ethnic food, transportation problems, and lack of financial management skills.
- 2) Assessing food insecurity among students with different school meal plans.
- 3) Investigating the overall impact of food insecurity on academic performance including prevalence of dropouts, grades, and absenteeism.
- 4) Investigating the differences in quality and variety of food purchased and consumed between food secure and insecure students.
- 5) To develop a validated instrument to assess students' expenditures.
- 6) Determining coping strategies adopted by UHM food insecure students deal with their food insecurity, such as use of credit cards.
- 7) Validating the use of the dietary question used for this study by biochemical indices or /and other dietary methods such as 24 hour recall.
- 8) Assessing the association between UHM students' nutrient intake and food insecurity.
- 9) Evaluating the impact of specific nutrient deficiencies on school performance, such as iron and its impact on energy, absenteeism, and scholastic achievement.

10) Studying the impact of food insecurity on mental health and prevalence of depression.

Strengths and Limitations of the Study

Strengths

To our knowledge, this study is the first study to identify this potential public health problem among a university population. Some of the strengths of this study include its successful recruitment plan and its relatively large sample size.

Limitations

Because of the unique population composition of Hawai'i and Hawai'i's high living expenses, this study cannot be generalized to other college students in the United States. This problem may exist on other campuses, but the explanatory factors are expected to be different.

Although students' response rate was very high (99%), we cannot but acknowledge that the low instructors' response rate (33%) may introduce some selection bias. In addition, results should be interpreted carefully since the survey depended on self-reported measures, such as overall health, concentration, energy level, and one-day food intake. Income data were not collected. Income, however, is a known predictor of food insecurity and of other factors measured in this study (e.g., health). Moreover, the dietary questionnaire did not represent the same time period as the food security questionnaire and therefore may not be representative. Also, some of our results from subgroup

analysis are based on small sample sizes. Lastly, this is a cross-sectional study, and therefore, causality cannot be established.

APPENDIX A (CONTINUED)

SURVEY INSTRUMENT USED IN THE STUDY

SECTION 3 (PARENT OF CHILD/CHILDREN)

	OFTEN	SOMETIMES	NEVER
1. I relied on only a few kinds of low-cost food to feed my child(ren) because I was running out of money to buy food.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2. I couldn't feed the child(ren) a balanced meal because I couldn't afford that.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3. My child(ren) was/were not eating enough because I just couldn't afford enough food	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

SECTION 4

In the last 12 months:	YES	NO
1. Did you or other adults in your house ever cut the size of your meals or skip meals because there wasn't enough money for food? (consider ONLY adults that share food expenses with you)	<input type="checkbox"/>	<input type="checkbox"/>
1a. If you answered YES to question 1, how often did this happen?		
<input type="checkbox"/> Almost every month <input type="checkbox"/> Some months but not every month <input type="checkbox"/> Only 1 or 2 months		
2. Did you ever eat less than you felt you should because there wasn't enough money to buy food?	<input type="checkbox"/>	<input type="checkbox"/>
3. Were you ever hungry but didn't eat because you couldn't afford enough food?	<input type="checkbox"/>	<input type="checkbox"/>
4. Did you lose weight because you didn't have enough money for food?	<input type="checkbox"/>	<input type="checkbox"/>
5. Did you or other adults in your house ever not eat for a whole day because there wasn't enough money for food? (consider ONLY adults that share food expenses with you)	<input type="checkbox"/>	<input type="checkbox"/>
5a. If you answered YES to question 5, how often did this happen?		
<input type="checkbox"/> Almost every month <input type="checkbox"/> Some months but not every month <input type="checkbox"/> Only 1 or 2 months		

IF YOU DON'T HAVE A CHILD OR CHILDREN THAT LIVES WITH YOU, PLEASE SKIP TO SECTION 6

SECTION 5 (PARENT OF CHILD/CHILDREN)

In the last 12 months:	YES	NO
1. Did you ever cut the size of your child(ren) meals because there wasn't enough money for food?	<input type="checkbox"/>	<input type="checkbox"/>
2. Did your child(ren) ever skip meals because there wasn't enough money for food?	<input type="checkbox"/>	<input type="checkbox"/>
2a. If you answered YES to question 2, how often did this happen?		
<input type="checkbox"/> Almost every month <input type="checkbox"/> Some months but not every month <input type="checkbox"/> Only 1 or 2 months		
3. Was/were your child(ren) ever hungry but you just couldn't afford more food?	<input type="checkbox"/>	<input type="checkbox"/>
4. Did your child(ren) ever not eat for a whole day because there wasn't enough money for food?	<input type="checkbox"/>	<input type="checkbox"/>

SECTION 6

In the last 12 months:	YES	NO
1. Did you ever get emergency food from a church, a food pantry or food bank, or eat in a community kitchen?	<input type="checkbox"/>	<input type="checkbox"/>
2. Did you receive benefits from the WIC (Women, Infants, and Children) Program?	<input type="checkbox"/>	<input type="checkbox"/>
3. Were you authorized to receive Food Stamps (including a food stamp voucher, or cash grants from the state for food)?	<input type="checkbox"/>	<input type="checkbox"/>
4. About how many months were you authorized to receive Food Stamps?	<input type="checkbox"/>	<input type="checkbox"/>
5. Are you now authorized to receive Food Stamps?	<input type="checkbox"/>	<input type="checkbox"/>
6. Did you receive food from any Private Organization, such as the Hawaii Community Foundation?	<input type="checkbox"/>	<input type="checkbox"/>

APPENDIX A (CONTINUED)

SURVEY INSTRUMENT USED IN THE STUDY

16. Do you consider yourself to be _____
 severely overweight overweight about the right weight
 underweight severely underweight
-

SECTION 8

1. What is your average living expense per month?
 \$0-500 \$501-750 \$751-1000 \$1001-1500 > \$1500
2. How much of this budget do you spend monthly on _____
- a. Housing (incl. utilities – electricity, water, gas, cable, and internet)
 \$0-500 \$501-750 \$751-1000 > \$1000
- b. Transportation (incl. car payments, car insurance, bus, and/or gas)
 \$0-50 \$51-100 \$101-150 \$151-200 > \$200
- c. Food
- Groceries
 \$0-50 \$51-100 \$101-150 \$151-200 > \$200
- Take out/eating out
 \$0-50 \$51-100 \$101-150 \$151-200 > \$200
- d. Entertainment (e.g., movies, drinks)
 \$0-50 \$51-100 \$101-150 \$151-200 > \$200
- e. Cell phone bill
 \$0-30 \$31-60 \$61-90 \$91-120 > \$120
- f. Shopping (e.g., clothes, shoes, household items)
 \$0-50 \$51-100 \$101-150 \$151-200 > \$200
3. In the past year how much did you spend on a one-time large expense such as school books, surfboards, or traveling?
 \$0-350 \$351-500 \$501-750 \$751-1000 > \$1000
-

1. About how many minutes did this questionnaire take you to complete?
 5-6 minutes 7-8 minutes 9-10 minutes > 10 minutes
2. Have you filled out this survey before? Yes No

THANK YOU FOR YOUR PARTICIPATION ☺

APPENDIX B

MAJOR CHANGES MADE TO THE SURVEY AFTER PILOT TESTING SESSION WITH NINE STUDENTS

Section	Question	Change
1	2	The question was rephrased to allow more specific YES/NO answers. "Here are some reasons why people don't always have enough to eat or don't always have the kinds of foods they want or need. For each reason, please indicate why you don't always have enough to eat or don't always have the kinds of food you want or need". Changed to: "For each one, please tell me if that is a reason why you don't always have enough to eat/always have the kinds of food you want or need."
4	1 and 5	The statement 'consider ONLY adults that share food expenses with you' was added to these questions

APPENDIX C

CHARACTERISTICS OF STUDENTS DECLARING THEMSELVES AS VEGETARIANS

What are your preferred dietary habits?

	Frequency	Percent	Cumulative Percent
Vegan (no animal)	3	8.8	8.8
Vegetarian (consumes fish only)	15	44.1	52.9
Vegetarian (no meat, poultry, fish)	8	23.5	76.5
Vegetarian (no red meat)	8	23.5	100.0
Total	34	100.0	

Food Security Status

	Frequency	Percent	Cumulative Percent
High	18	52.9	52.9
Marginal	12	35.3	88.2
Low	2	5.9	94.1
Very Low	2	5.9	100.0
Total	34	100.0	

Gender

	Frequency	Percent	Cumulative Percent
Female	30	88.2	90.9
Male	3	8.8	100.0
Total	33	97.1	
Missing data	1	2.9	
Total	34	100.0	

Marital status

	Frequency	Percent	Cumulative Percent
Divorced	2	5.9	5.9
Married	4	11.8	17.6
Single	28	82.4	100.0
Total	34	100.0	

APPENDIX C (CONTINUED)

**CHARACTERISTICS OF STUDENTS DECLARING THEMSELVES
AS VEGETARIANS**

Do you have children?

	Frequency	Percent	Cumulative Percent
No	31	91.2	91.2
Yes	3	8.8	100.0
Total	34	100.0	

Academic year

	Frequency	Percent	Cumulative Percent
Junior	3	8.8	9.1
Masters	7	20.6	30.3
Other	1	2.9	33.3
PhD	10	29.4	63.6
Senior	9	26.5	90.9
Sophomore	3	8.8	100.0
Total	33	97.1	
Missing data	1	2.9	
Total	34	100.0	

Living arrangement

	Frequency	Percent	Cumulative Percent
With parents/relatives	9	26.5	26.5
Alone	2	5.9	32.4
Off-campus unknown	2	5.9	38.2
On campus	5	14.7	52.9
With roommates	12	35.3	88.2
With spouse/partner	4	11.8	100.0
Total	34	100.0	

APPENDIX C (CONTINUED)

**CHARACTERISTICS OF STUDENTS DECLARING THEMSELVES
AS VEGETARIANS**

Major

	Frequency	Percent	Cumulative Percent
Animal Sciences	1	2.9	2.9
APDM	1	2.9	5.9
Ceramics	1	2.9	8.8
Clinical Psychology	1	2.9	11.8
Curriculum Studies	1	2.9	14.7
ECE	1	2.9	17.6
Education	3	8.8	26.5
Electrical Engineering	1	2.9	29.4
FAMR	1	2.9	32.4
Fashion Design	2	5.9	38.2
HRM	1	2.9	41.2
Computer Sciences	3	8.8	50.0
Marketing and Management	1	2.9	52.9
Math	1	2.9	55.9
Medicine	1	2.9	58.8
NREM	1	2.9	61.8
Philosophy	2	5.9	67.6
Psychology	3	8.8	76.5
SLS	1	2.9	79.4
Social Work	1	2.9	82.4
Sociology	1	2.9	85.3
TIM	2	5.9	91.2
Undecided	1	2.9	94.1
Undeclared	1	2.9	97.1
Zoology	1	2.9	100.0
Total	34	100.0	

Are you enrolled on a School Meal Plan?

	Frequency	Percent	Cumulative Percent
No	30	88.2	96.8
Yes	1	2.9	100.0
Total	31	91.2	
Missing data	3	8.8	
Total	34	100.0	

APPENDIX C (CONTINUED)

**CHARACTERISTICS OF STUDENTS DECLARING THEMSELVES
AS VEGETARIANS**

College

	Frequency	Percent	Cumulative Percent
Arts and Humanities	3	8.8	9.4
Business Administration	2	5.9	15.6
CTAHR	6	17.6	34.4
Education	5	14.7	50.0
Engineering	1	2.9	53.1
Languages, Linguistics, and Literature	1	2.9	56.3
Medicine	1	2.9	59.4
Natural Sciences	5	14.7	75.0
Social Sciences	5	14.7	90.6
Social Work	1	2.9	93.8
TIM	2	5.9	100.0
Total	32	94.1	
Missing data	2	5.9	
Total	34	100.0	

Where were you born?

	Frequency	Percent	Cumulative Percent
Another	10	29.4	29.4
Hawaii	11	32.4	61.8
Mainland	13	38.2	100.0
Total	34	100.0	

Ethnicity

	Frequency	Percent	Cumulative Percent
Chinese	5	14.7	14.7
Filipino	3	8.8	23.5
Japanese	5	14.7	38.2
Korean	1	2.9	41.2
Other	3	8.8	50.0
Two or more	3	8.8	58.8
White	14	41.2	100.0
Total	34	100.0	

APPENDIX C (CONTINUED)

**CHARACTERISTICS OF STUDENTS DECLARING THEMSELVES
AS VEGETARIANS**

Do you consume vitamins and/or minerals?

	Frequency	Percent	Cumulative Percent
No	16	47.1	48.5
Yes	17	50.0	100.0
Total	33	97.1	
Missing data	1	2.9	
Total	34	100.0	

Are you on any special diet?

	Frequency	Percent	Cumulative Percent
No	17	50.0	54.8
Yes	14	41.2	100.0
Total	31	91.2	
Missing	3	8.8	
Total	34	100.0	

If on a special diet, why?

	Frequency	Percent	Cumulative Percent
Maintain or improve health	5	14.7	16.1
Maintain or improve health & Weight loss	3	8.8	25.8
N/A	16	47.1	77.4
Other	3	8.8	87.1
Weight loss	4	11.8	100.0
Total	31	91.2	
Missing data	3	8.8	
Total	34	100.0	

APPENDIX C (CONTINUED)

**CHARACTERISTICS OF STUDENTS DECLARING THEMSELVES
AS VEGETARIANS**

Do you avoid any food group?

	Frequency	Percent	Cumulative Percent
No	7	20.6	21.9
Yes	25	73.5	100.0
Total	32	94.1	
Missing data	2	5.9	
Total	34	100.0	

If you avoid food groups, which one(s)?

	Frequency	Percent	Cumulative Percent
Dairy	1	2.9	3.0
Meats	22	64.7	69.7
Meats & Dairy	3	8.8	78.8
N/A	7	20.6	100.0
Total	33	97.1	
Missing data	1	2.9	
Total	34	100.0	

How would you rate your overall health?

	Frequency	Percent	Cumulative Percent
Fair	5	14.7	14.7
Good	23	67.6	82.4
Very good	6	17.6	100.0
Total	34	100.0	

How would you rate your concentration level?

	Frequency	Percent	Cumulative Percent
Fair	10	29.4	29.4
Good	18	52.9	82.4
Very good	5	14.7	97.1
Very poor	1	2.9	100.0
Total	34	100.0	

APPENDIX C (CONTINUED)

**CHARACTERISTICS OF STUDENTS DECLARING THEMSELVES
AS VEGETARIANS**

How would you rate your energy level?

	Frequency	Percent	Cumulative Percent
Fair	12	35.3	35.3
Good	17	50.0	85.3
Poor	1	2.9	88.2
Very good	4	11.8	100.0
Total	34	100.0	

What would you consider yourself to be?

	Frequency	Percent	Cumulative Percent
About the right weight	23	67.6	67.6
Overweight	9	26.5	94.1
Underweight	2	5.9	100.0
Total	34	100.0	

How much do you spend monthly on?

Housing

	Frequency	Percent	Cumulative Percent
\$0-500	16	47.1	51.6
\$1000+	3	8.8	61.3
\$501-750	9	26.5	90.3
\$751-100	3	8.8	100.0
Total	31	91.2	
Missing data	3	8.8	
Total	34	100.0	

APPENDIX C (CONTINUED)

**CHARACTERISTICS OF STUDENTS DECLARING THEMSELVES
AS VEGETARIANS**

Transportation

	Frequency	Percent	Cumulative Percent
\$0-50	17	50.0	53.1
\$101-150	5	14.7	68.8
\$151-200	2	5.9	75.0
\$200+	2	5.9	81.3
\$51-100	6	17.6	100.0
Total	32	94.1	
Missing data	2	5.9	
Total	34	100.0	

Groceries

	Frequency	Percent	Cumulative Percent
\$0-50	10	29.4	30.3
\$101-150	7	20.6	51.5
\$151-200	5	14.7	66.7
\$200+	6	17.6	84.8
\$51-100	5	14.7	100.0
Total	33	97.1	
Missing data	1	2.9	
Total	34	100.0	

Eating Out

	Frequency	Percent	Cumulative Percent
\$0-50	11	32.4	34.4
\$101-150	10	29.4	65.6
\$200+	1	2.9	68.8
\$51-100	10	29.4	100.0
Total	32	94.1	
Missing data	2	5.9	
Total	34	100.0	

APPENDIX C (CONTINUED)

**CHARACTERISTICS OF STUDENTS DECLARING THEMSELVES
AS VEGETARIANS**

Entertainment

	Frequency	Percent	Cumulative Percent
\$0-50	17	50.0	56.7
\$101-150	2	5.9	63.3
\$151-200	2	5.9	70.0
\$51-100	9	26.5	100.0
Total	30	88.2	
Missing data	4	11.8	
Total	34	100.0	

Cell phone

	Frequency	Percent	Cumulative Percent
\$0-30	12	35.3	40.0
\$31-60	11	32.4	76.7
\$61-90	6	17.6	96.7
\$91-120	1	2.9	100.0
Total	30	88.2	
Missing data	4	11.8	
Total	34	100.0	

Shopping

	Frequency	Percent	Cumulative Percent
\$0-50	12	35.3	38.7
\$101-150	7	20.6	61.3
\$151-200	5	14.7	77.4
\$51-100	7	20.6	100.0
Total	31	91.2	
Missing data	3	8.8	
Total	34	100.0	

APPENDIX C (CONTINUED)

**CHARACTERISTICS OF STUDENTS DECLARING THEMSELVES
AS VEGETARIANS**

One-time large expense (annual)

	Frequency	Percent	Cumulative Percent
\$0-350	2	5.9	5.9
\$1000+	14	41.2	47.1
\$351-500	8	23.5	70.6
\$501-750	6	17.6	88.2
\$751-100	4	11.8	100.0
Total	34	100.0	

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
Age (years)	34	19	49	25.79	6.875
How long have you lived in Hawaii? (years)	30	.33	29.00	10.3220	9.08847
Weight (Kg)	32	47.63	97.52	61.7888	12.22617
Height (meters)	29	1.50	1.90	1.6379	.08164
BMI	29	17.20	34.70	23.0793	4.07206
Hours sleep/day	33	5.00	9.00	6.8636	.90375
Hours exercise/day	32	.00	2.00	.7291	.54180
Grains (portions)	34	.00	7.00	2.8088	1.57641
Vegetables (portions)	33	.00	4.00	1.7273	1.10461
Fruits (portions)	33	.00	4.00	1.6515	1.22783
Dairy (portions)	32	.00	4.00	1.3906	1.02181
Meats & Beans (portions)	31	.00	6.00	1.6048	1.41388
Sweets (portions)	31	.00	3.00	.9032	.97826
Desserts (portions)	29	.00	3.00	.8793	.79793
Fat (portions)	30	.00	4.00	1.4333	1.10433
Alcohol (portions)	29	.00	3.00	.2414	.68947
Soy milk (portions)	32	.00	2.00	.5000	.71842
Ramen/saimin soup (portions)	31	.00	2.00	.3226	.59928
Plain coffee (cups)	10	1.00	3.00	1.5000	.70711
Specialty coffee (cups)	5	1.00	1.50	1.1000	.22361
Sodas (cups)	5	.50	5.00	1.9000	1.81659
Smoothies (cups)	3	1.00	1.00	1.0000	.00000
Water (cups)	22	1.00	8.00	4.2273	1.87545
Tea (cups)	12	1.00	3.00	1.5000	.67420
Canned juice (cups)	4	1.00	1.00	1.0000	.00000
Energy drinks (cups)	2	.25	1.00	.6250	.53033
Sports drinks (cups)	0				

APPENDIX C (CONTINUED)

**CHARACTERISTICS OF STUDENTS DECLARING THEMSELVES
AS VEGETARIANS**

The amount of food consumed yesterday is...

	Frequency	Percent	Cumulative Percent
Less than usual	5	14.7	16.1
More than usual	6	17.6	35.5
Usual	20	58.8	100.0
Total	31	91.2	
Missing data	3	8.8	
Total	34	100.0	

APPENDIX D

STUDENT RESPONSES TO FOOD SUFFICIENCY QUESTION

Which of these statements best describes the food eaten by you in the last 12 months?	N (%)
a. I always have enough to eat and the kinds of food I want	204 (51.6)
b. I have enough to eat but not always the kinds of food I want	174 (44.1)
c. Sometimes I don't have enough to eat	15 (3.8)
d. Often I don't have enough to eat	2 (0.5)
TOTAL	395 (100)

Reasons why students chose responses b, c, or d:

	Yes (%)	No (%)	Blank (%)	N/A (%)
Not enough money	25	21	5	49
Too hard to get to the store	23	21	6	50
On a diet	12	30	9	49
No working stove available	4	38	8	50
Not able to cook or eat (health problems)	2	39	9	50
Kinds of food I want not available	28	16	6	50
Good quality food not available	24	18	8	50

Other reasons listed:

- Time constraints (5%)
- Food I want is too expensive (i.e., organic food) (2%)
- Do not know how to cook (1%)
- Undesirable quality of foods/food available is unhealthy (1%)

APPENDIX E

STUDENTS' FOOD PROGRAM PARTICIPATION BY FOOD SECURITY STATUS

	High Food Secure n (%)	Marginally Food Secure n (%)	Low Food Secure n (%)	Very Low Food Secure n (%)
Emergency food from church, food pantry, food bank, or community kitchen	2 (25)	2 (33)	2 (50)	3 (30)
WIC	3 (38)	2 (33)	1 (25)	2 (20)
Food Stamps	2 (25)	2 (33)	1 (25)	3 (30)
Private Organization	1 (12)	0 (0)	0 (0)	2 (20)

Percentages represent column totals

APPENDIX F

PERCENT OF MONEY SPENT ON EACH OF THE SPENDING CATEGORIES ANOVA RESULTS

		Sum of Squares	df	Mean Square	F	Sig.
Percent spent housing	Between Groups	1,235.797	3	411.932	1.826	0.142
	Within Groups	85,703.884	380	225.537		
	Total	86,939.682	383			
Percent spent transportation	Between Groups	131.155	3	43.718	0.894	0.444
	Within Groups	18,580.055	380	48.895		
	Total	18,711.209	383			
Percent spent groceries	Between Groups	240.342	3	80.114	1.720	0.162
	Within Groups	17,702.968	380	46.587		
	Total	17,943.310	383			
Percent spent eating out	Between Groups	242.750	3	80.917	1.823	0.142
	Within Groups	16,862.491	380	44.375		
	Total	17,105.241	383			
Percent spent entertainment	Between Groups	152.262	3	50.754	1.062	0.365
	Within Groups	18,166.074	380	47.805		
	Total	18,318.336	383			
Percent spent cell phone	Between Groups	50.408	3	16.803	1.594	0.190
	Within Groups	4,005.030	380	10.540		
	Total	4,055.438	383			
Percent spent shopping	Between Groups	191.484	3	63.828	1.936	0.123
	Within Groups	12,529.911	380	32.973		
	Total	12,721.395	383			

APPENDIX G

AMOUNT OF MONEY SPENT ON FOOD (GROCERIES AND EATING OUT) MULTIVARIATE REGRESSION MODEL

Generalized Linear Models

Model Information

Dependent Variable	FSstatusNumeric(a)
Probability Distribution	Binomial
Link Function	Logit

a The procedure models 1.00 as the response, treating 2.00 as the reference category.

Case Processing Summary

	N	Percent
Included	340	83.3%
Excluded	68	16.7%
Total	408	100.0%

Continuous Variable Information

	N	Minimum	Maximum	Mean	Std. Deviation
Covariate FoodTotal\$100	340	.50	4.50	2.0779	1.07353

APPENDIX G (CONTINUED)

**AMOUNT OF MONEY SPENT ON FOOD (GROCERIES AND EATING OUT)
MULTIVARIATE REGRESSION MODEL**

Categorical Variable Information

			N	Percent
Dependent Variable	FSstatusNumeric	1.00 (FI)	71	20.9%
		2.00 (FS)	269	79.1%
		Total	340	100.0%
Factor	Gender	Male	145	42.6%
		Female	195	57.4%
		Total	340	100.0%
	Marital status	Single	290	85.3%
		Married	50	14.7%
		Total	340	100.0%
	Kids	Y	35	10.3%
		N	305	89.7%
		Total	340	100.0%
	Living arrangement	With spouse/partner	66	19.4%
		With roommates	61	17.9%
		On campus	40	11.8%
		Off-campus undetermined	35	10.3%
		Alone	36	10.6%
		With parents/relatives	102	30.0%
		Total	340	100.0%
	Ethnicity	White	91	26.8%
		Two or more	59	17.4%
		Other	24	7.1%
		Native Hawaiian/Pacific Islander	14	4.1%
		Korean	14	4.1%
		Filipino	35	10.3%
		Chinese	37	10.9%
		Japanese	66	19.4%
		Total	340	100.0%

APPENDIX G (CONTINUED)

**AMOUNT OF MONEY SPENT ON FOOD (GROCERIES AND EATING OUT)
MULTIVARIATE REGRESSION MODEL**

Tests of Model Effects

Source	Type III		
	Wald Chi-Square	df	Sig.
(Intercept)	.026	1	.871
FoodTotal\$100	7.154	1	.007
Gender	2.421	1	.120
Marital status	.166	1	.684
Kids	4.182	1	.041
Housing	15.972	5	.007
Ethnicity	16.837	7	.018

APPENDIX G (CONTINUED)

**AMOUNT OF MONEY SPENT ON FOOD (GROCERIES AND EATING OUT)
MULTIVARIATE REGRESSION MODEL**

Parameter Estimates

Parameter	B	Std. Error	95% Wald Confidence Interval		Hypothesis Test		
			Lower	Upper	Wald chi-square	df	Sig.
(Intercept)	-3.646	1.0157	-5.637	-1.655	12.885	1	0.000
FoodTotal\$100	-0.430	0.1610	-0.746	-0.115	7.154	1	0.007
[Gender=Male]	0.464	0.2985	-0.121	1.050	2.421	1	0.120
[Gender=Female]	0(a)	.	.	.	.	.	.
[Marital status=Single]	0.252	0.6177	-0.959	1.462	0.166	1	0.684
[Marital status=Married]	0(a)	.	.	.	.	.	.
[Kids=Y]	1.172	0.5731	0.049	2.295	4.182	1	0.041
[Kids=N]	0(a)	.	.	.	.	.	.
[Housing=With spouse/partner]	0.509	0.5874	-0.642	1.660	0.751	1	0.386
[Housing=With roommates]	1.658	0.4819	0.714	2.603	11.844	1	0.001
[Housing=On campus]	1.420	0.4890	0.462	2.379	8.434	1	0.004
[Housing=Off-campus undetermined]	1.294	0.5670	0.183	2.405	5.209	1	0.022
[Housing=Alone]	0.894	0.5957	-0.274	2.061	2.251	1	0.134
[Housing=With parents/relatives]	0(a)	.	.	.	.	.	.
[Ethnicity=White]	1.713	0.6633	0.413	3.013	6.667	1	0.010
[Ethnicity=Two or more]	2.291	0.6849	0.949	3.633	11.189	1	0.001
[Ethnicity=Other]	1.143	0.8448	-0.513	2.799	1.830	1	0.176
[Ethnicity=Native Hawaiian/Pacific Islanders]	2.703	0.8957	0.948	4.459	9.110	1	0.003
[Ethnicity=Korean]	1.454	0.9951	-0.497	3.404	2.134	1	0.144
[Ethnicity=Filipino]	2.445	0.7131	1.047	3.842	11.755	1	0.001
[Ethnicity=Chinese]	1.568	0.7752	0.049	3.088	4.094	1	0.043
[Ethnicity=Japanese]	0(a)	.	.	.	.	.	.

Dependent Variable: FSstatusNumeric

Model: (Intercept), FoodTotal\$100, Gender, Marital status, Kids, Housing, Ethnicity

a. Set to zero because this parameter is redundant.

APPENDIX H

AMOUNT OF FOOD EATEN THE DAY BEFORE THE SURVEY (USUAL, LESS THAN USUAL, MORE THAN USUAL) LOGISTIC REGRESSION ANALYSES

Generalized Linear Models

Model Information

Dependent Variable	FSstatusNumeric(a)
Probability Distribution	Binomial
Link Function	Logit

a The procedure models 1.00 as the response, treating 2.00 as the reference category.

Case Processing Summary

	N	Percent
Included	373	94.4%
Excluded	22	5.6%
Total	395	100.0%

Categorical Variable Information

			N	Percent
Dependent Variable	FSstatusNumeric	1.00 (FI)	73	19.6%
		2.00 (FS)	300	80.4%
		Total	373	100.0%
Factor	Amount of food	Less than usual	61	16.4%
		More than usual	37	9.9%
		Usual	275	73.7%
		Total	373	100.0%

Tests of Model Effects

Source	Type III		
	Wald Chi-Square	df	Sig.
(Intercept)	49.642	1	.000
amount_of_food	8.345	2	.015

Dependent Variable: FSstatusNumeric

Model: (Intercept), amount of food

APPENDIX H (CONTINUED)

**AMOUNT OF FOOD EATEN THE DAY BEFORE THE SURVEY
(USUAL, LESS THAN USUAL, MORE THAN USUAL)
LOGISTIC REGRESSION ANALYSES**

Parameter Estimates

Parameter	B	Std. Error	95% Wald Confidence Interval		Hypothesis Test		
			Lower	Upper	Wald Chi-Square	df	Sig.
(Intercept)	-1.579	0.1602	-1.893	-1.265	97.179	1	0.000
[amount of food=Less than usual]	0.172	0.3597	-0.533	0.877	0.229	1	0.632
[amount of food=More than usual]	1.083	0.3749	0.348	1.818	8.340	1	0.004
[amount of food=Usual]	0(a)	.	.	.	.	.	.
(Scale)	1(b)	.	.	.	.	.	.

Dependent Variable: FSstatusNumeric

Model: (Intercept), amount of food

a. Set to zero because this parameter is redundant.

b. Fixed at the displayed value.

APPENDIX I

DIETARY INTAKE AND INTAKE VERSUS RECOMMENDATIONS MULTIPLE REGRESSION AND MULTIVARIATE MODELS

Multiple regression model analyzing the association between grain consumption and food insecurity¹

Outcome variable	Coefficient	p-value²
Intercept	3.133	0.000
Food Security Status		
Food Insecure (n=72)	-0.864	<i>0.000</i>
Food Secure (n=293)	0*	
Gender		
Male (n=158)	0.547	<i>0.004</i>
Female (n=207)	0*	
Marital Status		
Single (n=311)	-0.049	0.876
Married (n=54)	0*	
Children		
Yes (n=38)	-0.07	0.848
No (n=327)	0*	
Amount of food eaten		
More than usual (n=37)	0.105	0.742
Less than usual (n=56)	-0.573	<i>0.028</i>
Usual (n=272)	0*	

¹ Adjusted for gender, marital status, having children and the amount of food reported to be eaten the day before the survey, total sample=365

² p-value <0.05 is statistically significant

* Set to zero because this parameter is redundant (reference category)

APPENDIX I (CONTINUED)

**DIETARY INTAKE AND INTAKE VERSUS RECOMMENDATIONS
MULTIPLE REGRESSION AND MULTIVARIATE MODELS**

Multiple regression model analyzing the association between fruit consumption and food insecurity¹

Outcome variable	Coefficient	p-value²
Intercept	1.881	0.000
Food Security Status		
Food Insecure (n=69)	-0.432	<i>0.008</i>
Food Secure (n=274)	0*	
Gender		
Male (n=155)	0.098	0.447
Female (n=188)	0*	
Marital Status		
Single (n=291)	-0.695	<i>0.001</i>
Married (n=52)	0*	
Children		
Yes (n=35)	-0.407	0.101
No (n=308)	0*	
Amount of food eaten		
More than usual (n=34)	-0.073	0.742
Less than usual (n=49)	-0.223	0.226
Usual (n=260)	0*	

¹ Adjusted for gender, marital status, having children and the amount of food reported to be eaten the day before the survey, total sample=343

² p-value <0.05 is statistically significant

* Set to zero because this parameter is redundant (reference category)

APPENDIX I (CONTINUED)

**DIETARY INTAKE AND INTAKE VERSUS RECOMMENDATIONS
MULTIPLE REGRESSION AND MULTIVARIATE MODELS**

Multiple regression model analyzing the association between dairy consumption and food insecurity¹

Outcome variable	Coefficient	p-value²
Intercept	1.679	0.000
Food Security Status		
Food Insecure (n=69)	-0.328	0.028
Food Secure (n=281)	0*	
Gender		
Male (n=154)	-0.013	0.909
Female (n=196)	0*	
Marital Status		
Single (n=300)	-0.227	0.244
Married (n=50)	0*	
Children		
Yes (n=35)	0.064	0.777
No (n=315)	0*	
Amount of food eaten		
More than usual (n=36)	-0.252	0.202
Less than usual (n=54)	-0.392	0.017
Usual (n=260)	0*	

¹ Adjusted for gender, marital status, having children and the amount of food reported to be eaten the day before the survey, total sample=350

² p-value <0.05 is statistically significant

* Set to zero because this parameter is redundant (reference category)

APPENDIX I (CONTINUED)

**DIETARY INTAKE AND INTAKE VERSUS RECOMMENDATIONS
MULTIPLE REGRESSION AND MULTIVARIATE MODELS**

Odds ratios for reporting not meeting 100% or more of MyPyramid recommendations by food security status

	Reported 100% of Recommendations					
	Grains			Vegetables		
	OR ¹	95% CI	<i>p</i> -value ²	OR ¹	95% CI	<i>p</i> -value ²
Food Insecure	1.35	0.38-4.79	0.641	2	0.76-5.28	0.164
Food Secure	1.00*			1.00*		

	Reported 100% of Recommendations					
	Fruits			Dairy		
	OR ¹	95% CI	<i>p</i> -value ²	OR ¹	95% CI	<i>p</i> -value ²
Food Insecure	3.67	1.69-7.96	<i>0.001</i>	1.79	0.81-3.97	0.153
Food Secure	1.00*			1.00*		

	Reported 100% of Recommendations		
	Meats & Beans		
	OR ¹	95% CI	<i>p</i> -value ²
Food Insecure	1.37	0.39-4.86	0.624
Food Secure	1.00*		

¹ Unadjusted Odds Ratio

² *p*-value <0.05 is statistically significant

* Reference category

APPENDIX I (CONTINUED)

**DIETARY INTAKE AND INTAKE VERSUS RECOMMENDATIONS
MULTIPLE REGRESSION AND MULTIVARIATE MODELS**

Multivariate logistic model predicting likelihood of reporting not meeting the recommendations for fruits by food security

Outcome variable	B	OR¹	95% CI	p-value²
Intercept	-0.276			0.494
Food Security Status				
Food Insecure (n=69)	1.279	3.59	1.54-8.36	0.003
Food Secure (n=272)	0*	1.00		
Gender				
Male (n=153)	0.662	1.94	1.15-3.27	0.013
Female (n=188)	0*	1.00		
Marital Status				
Single (n=289)	0.845	2.33	1.06-5.09	0.034
Married (n=52)	0*	1.00		
Children				
Yes (n=35)	0.412	1.51	0.57-3.97	0.404
No (n=306)	0*	1.00		
Amount of food eaten				
More than usual (n=34)	0.044	1.04	0.43-2.54	0.923
Less than usual (n=49)	0.628	1.87	0.82-4.29	0.138
Usual (n=258)	0*	1.00		

¹ Adjusted for gender, marital status, and having children

² p-value <0.05 is statistically significant

* Set to zero because this parameter is redundant (reference category)

APPENDIX J

MODE OF TRANSPORTATION LOGISTIC REGRESSION ANALYSES

Generalized Linear Models

Model Information

Dependent Variable	FSstatusNumeric(a)
Probability Distribution	Binomial
Link Function	Logit

a. The procedure models 1.00 as the response, treating 2.00 as the reference category.

Case Processing Summary

	N	Percent
Included	404	99.0%
Excluded	4	1.0%
Total	408	100.0%

Categorical Variable Information

			N	Percent
Dependent Variable	FSstatusNumeric	1.00 (FI)	86	21.3%
		2.00 (FS)	318	78.7%
		Total	404	100.0%
Factor	Mode of transportation	Bike	20	5.0%
		Bus	40	9.9%
		Car	231	57.2%
		Multiple	46	11.4%
		Other	16	4.0%
		Walk	51	12.6%
		Total	404	100.0%

APPENDIX J (CONTINUED)

**MODE OF TRANSPORTATION
LOGISTIC REGRESSION ANALYSES**

Tests of Model Effects

Source	Type III		
	Wald Chi-Square	df	Sig.
(Intercept)	38.976	1	0.000
Mode of transportation	18.677	5	0.002

Dependent Variable: FSstatusNumeric
Model: (Intercept), Mode of transportation

Parameter Estimates

Parameter	B	Std. Error	95% Wald Confidence Interval		Hypothesis Test		
			Lower	Upper	Wald Chi-Square	df	Sig.
(Intercept)	-0.693	0.2970	-1.275	-0.111	5.445	1	0.020
[Mode of transportation=Bike]	-0.154	0.5713	-1.274	0.965	0.073	1	0.787
[Mode of transportation =Bus]	-0.693	0.4945	-1.662	0.276	1.965	1	0.161
[Mode of transportation =Car]	-1.099	0.3516	-1.788	-0.410	9.766	1	0.002
[Mode of transportation =Multiple]	0.065	0.4290	-0.776	0.905	0.023	1	0.880
[Mode of transportation =Other]	0.182	0.5957	-0.985	1.350	0.094	1	0.760
[Mode of transportation =Walk]	0(a)	.	.	.	.	.	.
(Scale)	1(b)	.	.	.	.	.	.

Dependent Variable: FSstatusNumeric
Model: (Intercept), MaxOftransportation_mode
a. Set to zero because this parameter is redundant.
b. Fixed at the displayed value.

APPENDIX K

DISTORTED BODY PERCEPTION CHI-SQUARE ANALYSES AND DIFFERENCES BY GENDER

Chi-square analyses

	Food Secure N (%)	Food Insecure N (%)	Significance
Distorted body perception*			0.38
Yes	91 (35)	23 (41)	
No	170 (65)	33 (59)	

* Distorted body perception includes:

- 1) Being underweight and perceived yourself as either normal, overweight, or obese
- 2) Have a normal weight and perceived yourself as either underweight, overweight or obese
- 3) Being overweight and perceive yourself as either underweight, normal, or obese, and
- 4) Being obese and perceive yourself as either underweight, normal, or overweight.

Differences in body perception by gender

Food Secure

Actual BMI	Body perception							
	Underweight		Normal Weight		Overweight		Obese	
	Male (N)	Female (N)	Male (N)	Female (N)	Male (N)	Female (N)	Male (N)	Female (N)
Underweight	0	5	1	9	0	0	0	0
Normal Weight	8	3	39	88	2	23	0	1
Overweight	0	0	22	5	16	18	0	0
Obese	0	0	0	0	9	8	1	2

APPENDIX K (CONTINUED)

**DISTORTED BODY PERCEPTION
CHI-SQUARE ANALYSES AND DIFFERENCES BY GENDER**

Food Insecure

Actual BMI	Body perception							
	Underweight		Normal Weight		Overweight		Obese	
	Male (N)	Female (N)	Male (N)	Female (N)	Male (N)	Female (N)	Male (N)	Female (N)
Underweight	0	0	0	1	0	0	0	0
Normal Weight	4	1	12	14	1	5	0	0
Overweight	0	0	7	1	4	3	0	0
Obese	0	0	1	0	1	1	0	0

APPENDIX L

RELATIONSHIP BETWEEN FOOD INSECURITY AND OVERWEIGHT AND OBESITY BY GENDER LOGISTIC REGRESSION ANALYSES

MEN

Generalized Linear Models

Model Information

Dependent Variable	FSstatusNumeric(a)
Probability Distribution	Binomial
Link Function	Logit

a. The procedure models 1.00 as the response, treating 2.00 as the reference category.

Case Processing Summary

	N	Percent
Included	127	99.2%
Excluded	1	0.8%
Total	128	100.0%

Categorical Variable Information

			N	Percent
Dependent Variable	FSstatusNumeric	1.00 (FI)	30	23.6%
		2.00 (FS)	97	76.4%
		Total	127	100.0%
Factor	BMI group	Overweight	50	39.4%
		Obese	12	9.4%
		Normal	65	51.2%
		Total	127	100.0%

APPENDIX L (CONTINUED)

**RELATIONSHIP BETWEEN FOOD INSECURITY AND
OVERWEIGHT AND OBESITY BY GENDER
LOGISTIC REGRESSION ANALYSES**

Tests of Model Effects

Source	Type III		
	Wald Chi-Square	df	Sig.
(Intercept)	19.232	1	0.000
BMIgroup	0.619	2	0.734

Dependent Variable: FSstatusNumeric

Model: (Intercept), BMIgroup

Parameter Estimates

Parameter	B	Std. Error	95% Wald Confidence Interval		Hypothesis Test		
			Lower	Upper	Wald Chi-Square	df	Sig.
(Intercept)	-1.038	0.2822	-1.591	-0.485	13.526	1	0.000
[BMIgroup=Overweight]	-0.228	0.4430	-1.096	0.640	0.264	1	0.607
[BMIgroup=Obese]	-0.571	0.8244	-2.187	1.044	0.480	1	0.488
[BMIgroup=Normal]	0(a)	.	.	.	.	.	.
(Scale)	1(b)	.	.	.	.	.	.

Dependent Variable: FSstatusNumeric

Model: (Intercept), BMIgroup

a. Set to zero because this parameter is redundant.

b. Fixed at the displayed value.

APPENDIX L (CONTINUED)

**RELATIONSHIP BETWEEN FOOD INSECURITY AND
OVERWEIGHT AND OBESITY BY GENDER
LOGISTIC REGRESSION ANALYSES**

WOMEN

Generalized Linear Models

Model Information

Dependent Variable	FSstatusNumeric(a)
Probability Distribution	Binomial
Link Function	Logit

a. The procedure models 1.00 as the response, treating 2.00 as the reference category.

Case Processing Summary

	N	Percent
Included	190	100.0%
Excluded	0	0.0%
Total	190	100.0%

Categorical Variable Information

			N	Percent
Dependent Variable	FSstatusNumeric	1.00 (FI)	28	14.7%
		2.00 (FS)	162	85.3%
		Total	190	100.0%
Factor	BMIgroup	Underweight	16	8.4%
		Overweight	27	14.2%
		Obese	11	5.8%
		Normal	136	71.6%
		Total	190	100.0%

Tests of Model Effects

Source	Type III		
	Wald Chi-Square	df	Sig.
(Intercept)	29.319	1	0.000
BMIgroup	0.388	3	0.943

Dependent Variable: FSstatusNumeric

Model: (Intercept), BMIgroup

APPENDIX L (CONTINUED)

**RELATIONSHIP BETWEEN FOOD INSECURITY AND
OVERWEIGHT AND OBESITY BY GENDER
LOGISTIC REGRESSION ANALYSES**

Parameter Estimates

Parameter	B	Std. Error	95% Wald Confidence Interval		Hypothesis Test		
			Lower	Upper	Wald Chi-Square	df	Sig.
(Intercept)	-1.700	0.2373	-2.166	-1.235	51.343	1	0.000
[BMIgroup=Underweight]	-0.246	0.7923	-1.798	1.307	0.096	1	0.757
[BMIgroup=Overweight]	-0.049	0.5914	-1.208	1.110	0.007	1	0.934
[BMIgroup=Obese]	-0.602	1.0753	-2.710	1.505	0.314	1	0.575
[BMIgroup=Normal]	0(a)	.	.	.	.	.	.
(Scale)	1(b)	.	.	.	.	.	.

Dependent Variable: FSstatusNumbers

Model: (Intercept), BMIgroup

a. Set to zero because this parameter is redundant.

b. Fixed at the displayed value.

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