Evaluating the Efficacy of On-campus Food Access Programs through the Assessment of Changes in Diet-related Biomarkers in College Students

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Background

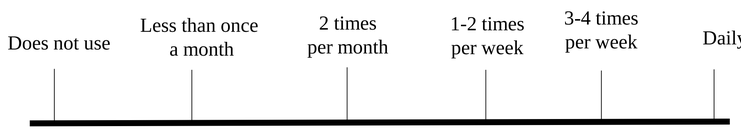
- College students are a vulnerable population of emerging adults at risk for food insecurity due to tuition costs, cost of campus housing, and other financial obligations.[1, 2]
- UC Davis has developed on-campus resources to address food insecurity, including the Aggie Compass Basic Needs Resource Center, which houses the undergraduate and graduate student food pantries, Fruit and Veggie-Up, CalFresh, and other means for acquiring food items, inclusive of free fresh fruits and vegetables.
- The consumption of fruits and vegetables is associated with improved biomarkers for health and diet quality, and the reduction of chronic disease risk.[3]
- Improving food security status leads to improvements to academic performance and decreased drop-out rates, as well as lower perceived stress levels, and other physical and mental health improvements.[3,4]
- Although on-campus food access resources are widely utilized on the UC Davis campus, little research has been conducted to evaluate the effectiveness on student health outcomes.

Objectives

- To determine whether students utilizing food access resources at the University of California, Davis have improvements in biomarkers for health and higher fruit and vegetable consumption compared to students not utilizing on-campus food access resources
- To validate Diet ID against biomarkers in the blood and skin, along with dietary intake and diet quality in a diverse population of college students (forthcoming)

Methods

- All study protocols were approved by the UC Davis Institutional Review Board
- Undergraduate and graduate students were recruited
  - Cohort 1: n = 48
  - Cohort 2: pending recruitment Winter 2021 (due to COVID-19)
- Participation in on-campus food access resources was categorized based on frequency of use



- Health and diet quality were assessed by:

Blood samples: plasma and serum was aliquoted and stored for future carotenoid, lipid profiles, and non-esterified fatty acid analysis

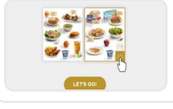
Skin carotenoid scores (SCS): Veggie Meter™

Anthropometrics: body mass index (BMI)

Food security status (FSS): USDA 10-item food security checklist

Nutrition knowledge: validated questionnaire for adults[5]

Dietary recalls and diet quality: Nutrition Data System for Research (NDSR) and alternative Healthy Eating Index 2015 (aHEI)



Dietary patterns: Diet ID™, an online system for monitoring dietary behaviors and patterns

Preliminary Results

Table 1. Mean ± standard deviations of age, BMI, SCS, and nutrition knowledge of participants and the number and percentage of participants in subgroup by sex, race/ethnicity, academic standing, first generation student status, and food security status

Age, years (mean ± SD) (n = 48)	22.09 ± 2.36
Sex (n = 48)	
Male	12 (25%)
Female	36 (75%)
Race/Ethnicity (n = 43)	
African American/Black, not of Hispanic origin	0 (0%)
American Indian/Alaska native	0 (0%)
Asian/Pacific Islander	23 (54%)
Caucasian/White, not of Hispanic origin	9 (21%)
Latin/Hispanic (Mexican-American, Puerto Rican, Cuban)	10 (23%)
Other	1 (2%)
Academic Standing (n = 43)	
Sophomore (2nd year)	9 (21%)
Junior (3rd year)	15 (35%)
Senior (4th year)	11 (26%)
Senior (> 4th year)	1 (2%)
Graduate	7 (16%)
First Generation Student (n = 43)	
Yes	18 (42%)
No	25 (58%)
Food Security Status (n = 48)	
High	19 (44%)
Marginal	15 (35%)
Low	8 (19%)
Very Low	6 (14%)
BMI (mean ± SD; kg/m^2) (n = 48)	
Total	24.58 ± 5.04
Male	25.79 ± 4.47
Female	24.18 ± 5.22
SCS (mean ± SD) (n = 48)	322.98 ± 114.42
Nutrition Knowledge (mean ± SD) (n = 40)	37.95 ± 8.16

SCS and FSS

- As students become more food insecure, there was a decrease in SCS by 36.86 points (p = 0.02) per category

BMI and FSS

- As students become more food insecure, BMI increased by 1.15 kg/m^2 (p = 0.022) per category

Nutrition Knowledge and SCS

- For every one-point increases in nutrition knowledge score, there was an increase in SCS by 4.45 (p = 0.027)

SCS and Differences by Sex

- In men, for every one-point increase in nutrition knowledge score, SCS increased by 8.16 (p = 0.005), independent of BMI
- In women, SCS was not associated with nutrition knowledge, however, SCS was contingent on BMI. For every 2.72-unit increase in BMI score, there was a decrease in SCS by 376.68 (p = 0.001)

FSS and Food Access Resources

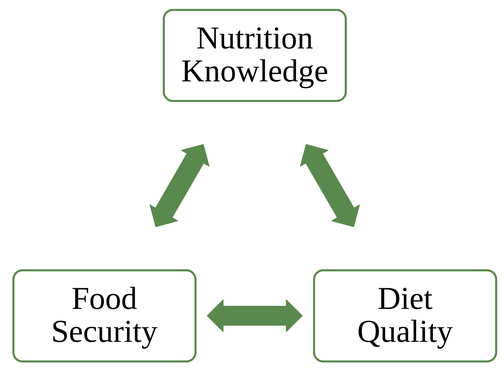
- FSS was not predictive of the frequency of using on-campus food access resources (p = 0.22)

Preliminary Conclusions

- Preliminary findings confirmed a positive relationship between SCS and FSS
- We observed a negative relationship between BMI and FSS
- Higher nutrition knowledge scores were associated with higher SCS
- The preliminary findings showed sex differences:
  - In male participants, the significant predictor of SCS was nutrition knowledge, independent of BMI
  - In female participants, the significant predictors of SCS were BMI and FSS; nutrition knowledge was not a significant predictor
- FSS did not predict food access resource usage

Implications

- Nutrition knowledge was a predictor of fruit and vegetable consumption in male participants. Increasing nutrition knowledge may improve fruit and vegetable intake in both sexes, thus effecting subsequent biomarkers associated with improvements in diet quality.
- A relationship between FSS and BMI was confirmed in female but not in male participants. This confirms previous findings that FSS has a greater effect on BMI in females than males.[6] This finding may inform future interventions aimed at improving FSS and decreasing BMI to improve health and diet quality.
- Skin carotenoid scores were impacted by low and very low FSS; therefore, food access resources should focus on serving high-need students and providing nutrient-rich foods, such as fresh fruits and vegetables.



Future Analysis Plan

- Study will resume in January 2021
- Analyze dietary data (NDSR) and calculate diet quality using Alternative Healthy Eating Index-2015
- Test associations between food access resource usage and biomarkers of interest
- Analyze intrasubject changes from baseline visit to follow-up visit to determine if health and diet-related biomarkers are modified with on-campus food access resource usage
- Detect and quantify biomarkers of interest from the blood samples
- Perform validation on the following data:
  - Compare Diet ID data against aHEI scores derived from NDSR dietary recall data, plasma carotenoids, and SCS
  - Compare carotenoid levels as measured by LC-MS and Veggie Meter™ relative to dietary intake from NDSR and Diet ID

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