UNIVERSITY OF KENTUCKY
CENTER FOR POVERTY RESEARCH

Discussion Paper Series
DP 2021 - 06

ISSN: 1936-9379

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July 2021

Preferred citation:
Leung, C., Wolfson, J., Insolera, N., & Cohen, A. (2021, July). Long-term impacts of college students' food insecurity on future socioeconomic status, wealth, and food insecurity. *University of Kentucky Center for Poverty Research Discussion Paper Series, DP2021-06*, Retrieved [Date] from http://ukcpr.org/research.

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Long-Term Impacts of College Students' Food Insecurity on Future Socioeconomic Status, Wealth, and Food Insecurity

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This project was supported with a grant from the University of Kentucky Center for Poverty Research through funding by the U.S. Department of Agriculture, Economic Research Service, Agreement Number 58-4000-6-0059-R. The opinions and conclusions expressed herein are solely those of the author(s) and should not be construed as representing the opinions or policies of the sponsoring agencies

ABSTRACT

Food insecurity, a condition of limited access to nutritious food, is a critical issue for college students' health and well-being. In this report, we present results from our project that examines the long-term effects of college students' food insecurity on future socioeconomic status, wealth, and food insecurity using nationally representative data from the Panel Study of Income Dynamics. Our study population included 1,574 individuals who were enrolled in college between 1999-2003, aged 16-29 years old during college enrollment, and remained in the sample through 2015-17. We examined the associations of interest using a combination of linear, logistic, multinomial logistic, and fixed-effects regression models, adjusting for sociodemographic characteristics measured concurrent with college enrollment or during childhood. In the sample, the prevalence of food insecurity during college was 14.9%. College food insecurity was associated with lower odds of college completion and lower likelihood of obtaining a Bachelor's degree or a graduate or professional degree. These associations were more pronounced among first-generation college students. College food insecurity was also associated with lower mean labor wage income and lower wealth accumulation (including home equity) across subsequent survey waves between 2005-2019. Finally, college food insecurity was associated with a higher prevalence of food insecurity in the later adult years (measured in 2015-17). Results suggest that college food insecurity has long-term implications for socioeconomic outcomes in adulthood. Future research should focus on the role of programs and policies that can break the cycle of chronic food insecurity and poverty over the life course.

EXECUTIVE SUMMARY

Food insecurity, a condition of limited access to nutritious food, is a critical issue for college students' health and well-being. As more individuals have been able to attend college due to financial aid and scholarship programs, these programs fall short in covering the full cost of tuition and fees, room, board, and other academic expenses. As a result, students are struggling to meet their basic needs, leading to high levels of food insecurity on college campuses. Studies have shown that food insecurity among college students is associated with poorer health behaviors and lower academic achievement. However, no study has examined the long-term effects of college food insecurity on future socioeconomic status, wealth, and food insecurity. We address these gaps by using longitudinal data from the nationally representative Panel Study of Income Dynamics (PSID).

We created a balanced panel of 1,574 individuals who were aged 16-29 years old, enrolled in ≥1 year of college between 1999-2003, and remained in the sample through follow-up (2015-17). Food security was measured using the 18-item Household Food Security Survey Module, which was reported by the head/reference person or spouse/partner of the PSID household. Outcomes of interest included individual highest educational attainment, individual unemployment status between 2005-2019, family wealth accumulation and individual labor income between 2005-2019, and family food security status between 2015-2017. We examined the associations of interest using a combination of linear, logistic, multinomial logistic, and fixed-effects regression models, adjusting for sociodemographic characteristics measured concurrent with college enrollment or during childhood.

The overall prevalence of food insecurity during college was 14.9%. College students who experienced food insecurity were more likely to be non-White ($P<0.001$), a first-generation

college student (*P<0.001*), and have lower incomes (*P<0.001*), compared to college students who were food-secure. Below, we describe our main findings of the project:

- College food insecurity was associated with lower odds of college completion (OR 0.46, 95% CI 0.30, 0.70), and lower likelihood of obtaining a Bachelor's degree (RRR 0.45, 95% CI 0.30, 0.69) or a graduate or professional degree (RRR 0.25, 95% CI 0.12, 0.55). These associations were more significant for first-generation college students.
- College food insecurity was not associated with lower odds of future unemployment (5.9% for students with food insecurity vs. 5.3% for students with food security, *P=0.49*).
- Among individuals who were working part-time or full-time after college, college food insecurity was associated with lower mean labor wage income ($26.96 for students with food insecurity vs. $30.54 for students with food security, *P=0.002*).
- College food insecurity was associated with lower average future family wealth including home equity ($76,270.85 for students with food insecurity vs. $111,510 for students with food security, *P=0.02*).
- College food insecurity was associated with a higher prevalence of future food insecurity (PR 1.45, 95% CI 1.16, 1.81). This association was more significant for students who were economically independent from their parents while attending college between 1999 and 2003.

Results from this project highlight the negative longitudinal effects of experiencing food insecurity during the college years on future socioeconomic status, wealth, and food insecurity. College food insecurity was associated with lower rates of college graduation and lower degree attainment, particularly among first-generation students. College food insecurity was associated with lower labor income and lower total family wealth including home equity, which is likely

mediated by lower educational attainment. And finally, college food insecurity was associated with a higher prevalence of food insecurity in early to middle adulthood, predominantly among students who were economically independent during college. This association is also likely mediated by lower educational attainment and lower wealth accumulation during the post-college years. These findings demonstrate the long-term significance of experiencing food insecurity during the critical college years and underscore the need for policy interventions to potentially break the cycle of chronic food insecurity and poverty over the life course.

INTRODUCTION

Food insecurity, a condition of inadequate food availability due to a lack of money and other resources, is a serious issue among college students. Compared to only 11% in the general population, food insecurity has been estimated to affect 35-42% of college students.[1-3] This wide disparity in food insecurity has been attributed to the changing demographics of college students over the past several decades. More and more college students are financially independent from their parents, the first in their family to attend college (i.e. first generation), have delayed their postsecondary education, and/or are a parent to a child.[4] More students are also able to attend college due to financial aid and scholarship programs; however, these programs do not cover the full cost of tuition and fees, room, board, and other necessities. For example, the federal Pell grant, which is awarded to low-income students, covers only 19% of the full cost of a public 4-year college.[4] As a result, students are struggling to meet their basic needs and accruing substantial debt as a result of college attendance, subsequently impacting their short-term economic outcomes and long-term socioeconomic trajectories.

Until recently, food insecurity was an invisible issue on most college campuses. As more research on the prevalence of and risk factors for student food insecurity has emerged, there have been common themes across published studies. Minority race/ethnicity and financial independence are consistent risk factors for student food insecurity.[5-8] Student food insecurity is associated with lower grade point averages (GPA) and higher likelihood of withdrawing from a class or their institution.[7,9-12] Our prior research at the University of Michigan (U-M) has shown that the prevalence of food insecurity was 31% in 2018, with females, students of minority race/ethnicity, first-generation college students, and students receiving financial aid at higher risk.[13] Students experiencing food insecurity also reported lower diet quality, higher body mass

indices, and lower GPAs than their food-secure counterparts.[13,14] There are many unanswered questions about the long-term effects of food insecurity, particularly in relation to future socioeconomic status, wealth and food insecurity. The current project leverages longitudinal, nationally representative data from the Panel Study of Income Dynamics to address these important gaps.

RESEARCH METHODS

The overall goal of this project is to examine the long-term effect of food insecurity during college on future socioeconomic status, wealth, and food insecurity. Our three study aims draw on Life Course Theory, which broadly incorporates environmental and contextual factors to explain disparities over time.[15,16] The three aims of this project are:

- Aim 1: Examine how college food insecurity affects educational attainment and future employment.
- Aim 2: Examine how college food insecurity affects future income and wealth accumulation.
- Aim 3: Examine how college food insecurity affects future food insecurity and SNAP participation.

We hypothesized that college food insecurity will be associated lower educational attainment and less stable future employment patterns. We also hypothesized that college food insecurity will be associated with lower future earnings and lower wealth accumulation. Finally, we hypothesized that college food insecurity will be associated with higher likelihood of future food insecurity and SNAP participation.

DATA

Study population

Data for this project came from the Panel Study of Income Dynamics (PSID). The PSID is the world's longest running household panel survey designed to be representative of the U.S. population. Since data collection began in 1968, the PSID has followed the original 5,000 family sample and their descendants, collecting data on sociodemographic, economic, and health characteristics annually through 1997 and biennially thereafter.[17]

In the 1999, 2001, and 2003 surveys, PSID measured food security status for the first time using the 18-item Household Food Security Survey Module (HFSSM). The analytic population for this project was restricted to individuals who were enrolled in college between 1999-2003 and with non-missing food security status during those years. College enrollment between 1999-2003 was defined using a number of questions in various PSID surveys, including: 1) student status as of interview, 2) month and year of high school graduation or GED completion, 3) number of years attended college, 4) dates of college attendance, and 5) whether an individual was a student in the last calendar year. We created a balanced panel of 1,574 individuals who were aged 16-29 years old in 1999, 2001, or 2003, enrolled in ≥1 year of college between 1999-2003, and remained in the sample through follow-up (2015-17).

Food insecurity

For all aims, the primary exposure of interest was food security status measured between 1999-2003 concurrent with the PSID participant's college enrollment (i.e. college food insecurity). Food security status was reported using the 18-item HFSSM.[18] Questions are asked in three stages of growing severity about experiences or behaviors related to insufficient

resources to acquire food over the past 12 months. Ten questions pertain to adults' experiences of food insecurity; eight questions pertain to children's experiences of food insecurity, which are omitted if no children are present. Across the 18 questions, affirmative responses are summed to create a score ranging from 0-18, which a higher score denoting more severe experiences of food insecurity.

Because food insecurity is a family level measure, we prioritized direct measurement of the college student's food insecurity status. Therefore, if at any point from 1999-2003, an individual was a head/reference person or spouse/partner of their own household while in college, we used that food security score. If an individual was not the head/reference person or spouse/partner of their own household from 1999-2003, but was living in the home of the primary respondent while in college, we used that food security score. The remaining individuals were dependents of the primary respondent but lived away at school at the time of interview when they were enrolled in college, so the food security score is that of the primary respondent's (i.e. parent/caregiver) household. Following this hierarchy, we coded food security status for each wave in which the individual was a college student. We then created a binary measure of food insecurity from 1999-2003, coded as 1 if the individual was ever food-insecure while in college and 0 if they were never food-insecure while in college. For the current project, college food insecurity was classified as having a score of ≥1 on the HFFSM during the 1999-2003 surveys concurrent with participants' college enrollment period.

Outcomes of interest

For Aim 1, the primary outcome was educational attainment. Educational attainment was assessed based on two household interview questions in the 2015-17 survey waves about

whether the respondent completed college and, if so, the highest degree they obtained. We then created a categorical measure of educational attainment with the following four categories: 1) a binary measure of whether or not the individual completed college, and 2) a categorical measure of the type of degree they received (no degree, Associate's degree, Bachelor's degree, or graduate/professional degree). A secondary outcome was unemployment status, which was a binary indicator of employment status at the time of interview. This variable was time varying for each head/reference person or spouse/partner from 2005-2019, equaling 1 if the individual reported being 'unemployed and looking for work'.

For Aim 2, the primary outcomes were wealth accumulation and labor income. Wealth accumulation was measured continuously using two generated variables of net worth 1) not including home equity, and 2) including home equity. These measures take into account all assets and subtract out all debts asked about in the survey instrument, are collected at the family level, and were collected for each head/reference person or spouse/partner from 2005-2019. All values were inflated to 2019 dollars using the U.S. Bureau of Labor Statistics' Consumer Price Index Inflation Calculator, and values could be negative.[19] Average labor wage was inflated to 2019 dollars, collected at the individual for each head/reference person or spouse/partner, and was time varying from 2005-2019. Average labor wage was calculated by taking the total labor income in a specified year and dividing it by the total hours worked in that same year for each individual.

For Aim 3, the primary outcome was food security status measured between 2015-17 (i.e. food insecurity during adulthood) using the HFSSM. Individuals were categorized as food-insecure if they had a score ≥1 on the HFFSM in either 2015 or 2017. Because PSID did not collect food security data between 2005-2013, we also examined whether the PSID participant's

household received SNAP in the PSID surveys from 2005 and later as a proxy measure of food distress.

Covariates

For all analyses, we considered the following covariates measured during college: age (continuous), sex (male/female), race/ethnicity (non-Hispanic White/other), income to needs ratio (continuous), marital status (single/married), whether the individual is a parent to a child (yes/no), and household position (head/reference person or spouse/partner of own household, family member living in the home of the primary respondent (known as "Other Family Unit Member" (OFUM)), or a family member of the primary respondent living away at school (known as "Institutional OFUM"). We also considered first-generation student status (i.e. neither parent had graduated from college), and childhood receipt of Supplemental Nutrition Assistance Program (SNAP) benefits (ever/never).

Statistical Analysis

PSID longitudinal survey weights were applied to all analyses to account for sample attrition, clustering, and to generate nationally representative estimates. Descriptive statistics were used to compare distributions of sociodemographic characteristics by college food insecurity status. For Aim 1, we used logistic regression models to estimate the odds of graduating from college, and multinomial logistic regression models to estimate the odds of different degree types, adjusting for all study covariates. We further examined interactions in these associations by first-generation student status. We used post-estimation margins to generate the predicted probability of being in each level of educational attainment by levels of food

insecurity and first-generation student status while holding all study covariates constant. To examine college food insecurity and unemployment patterns, we conducted a fixed-effects logistic regression model to estimate the odds of being unemployed at each PSID survey wave from 2005-2019. We then used post-estimation margins to generate the predicted probability of being unemployed by college food insecurity status, adjusting for all study covariates.

For Aim 2, we used linear fixed-effects models to examine the associations between college food insecurity and labor wage and wealth at each PSID survey wave from 2005-2019. We fit three sets of models: 1) unadjusted,) adjusted for age, sex, race, marital status, parent to a child, and household position, and 3) adjusted for all prior covariates, income to needs ratio, and whether the individual attained a college degree.

For Aim 3, we used multivariable generalized linear models to estimate prevalence ratios (PR) for future food insecurity in relation to college food insecurity, adjusting for all study covariates. We further stratified analyses by whether the PSID participant was economically independent during college – defined as holding the position of head/reference person or spouse/partner of their own PSID household.

Across all aims, statistical tests were two-sided and significance was considered at $P<0.05$. Statistical analyses were performed using Stata/SE 14.2 (Stata Corp, College Station, TX).

RESULTS

In the analytic population of 1,574 PSID participants, the mean age during the period of 1999-2003 was 21.6 ($\pm$0.13) years. The majority of adults were female (54.5%), Non-Hispanic white (73.9%) and a first-generation college student (54.3%).

The overall prevalence of food insecurity during college was 14.9%. Individuals who experienced food insecurity in college were more likely to have lower income (*P<0.001*), non-White (*P<0.001*), a first-generation student (*P<0.001*), and hold the household position of head/reference person, spouse/partner or OFUM (*P<0.001*), compared to individuals who were food-secure in college (**Table 1**). There were no differences in mean age or sex by college food security levels.

Table 1. Characteristics of the study sample by college food insecurity (n=1574)

	All		**Food-secure**		**Food-Insecure**		***P-value***
	n	**%**	**n**	**%**	**n**	**%**	
Total	1574	100%	1257	85.1	317	14.9	
1999-2003							
Age [mean (SD)]	21.62	(0.13)	21.61	(0.13)	21.75	(0.31)	*0.656*
Income to needs ratio [mean (SD)]	5.23	(23.3)	5.78	(0.26)	2.18	(0.13)	*<0.001*
Sex							
Male	648	45.5	526	45.8	122	43.7	*0.64*
Female	926	54.5	731	54.2	195	56.3	
Race/ethnicity							
Non-Hispanic White	892	73.9	796	78	96	50.7	*<0.001*
Other	562	16.2	368	12.3	194	38.5	
First-generation student							
Yes	959	54.3	699	50.4	260	77	*<0.001*
No	615	45.7	558	49.6	57	23	
Household position							
Head/spouse/partner	306	21.6	234	20	72	30.4	*<0.001*
Institutional OFUM	338	22.6	297	24.8	41	10.2	
OFUM	930	55.8	726	55.2	204	59.3	

OFUM, Other Family Member

<u>Aim 1</u>: Examine how college food insecurity affects educational attainment and future employment.

In bivariate analyses, college food insecurity was inversely associated with college degree completion and educational attainment. Among food-insecure college students, 43.8% completed their college degree compared with 68.1% of food-secure college students (P<0.001).

Among college students who completed a degree, those who experienced food insecurity were more likely to get an Associate's degree (13.9% vs. 10.9%) and were less likely to receive a Bachelor's (21.1% vs. 35.8%) or graduate/professional degrees (7.6% vs. 21.2%) than their food-secure counterparts.

Table 2 presents associations between college food insecurity and college completion and degree attained. After adjustment for age, sex, race/ethnicity, and household position, food insecurity during college was associated with lower odds of college completion (OR 0.46, 95% CI: 0.30, 0.70), and lower likelihood of obtaining a Bachelor's degree (RRR 0.45, 95% CI: 0.30, 0.69) or a graduate or professional degree (RRR 0.25, 95% CI: 0.12, 0.55). After further adjustment for first-generation status and poverty level, college food insecurity remained significantly associated with lower odds of college graduation (OR 0.57, 95% CI: 0.37, 0.88,) and lower likelihood of obtaining a Bachelor's degree (RRR 0.57, 95% CI: 0.35, 0.92) or Graduate/professional degree (RRR 0.39, 95% CI: 0.17, 0.86).

Table 2. College food insecurity and college completion and degree attained

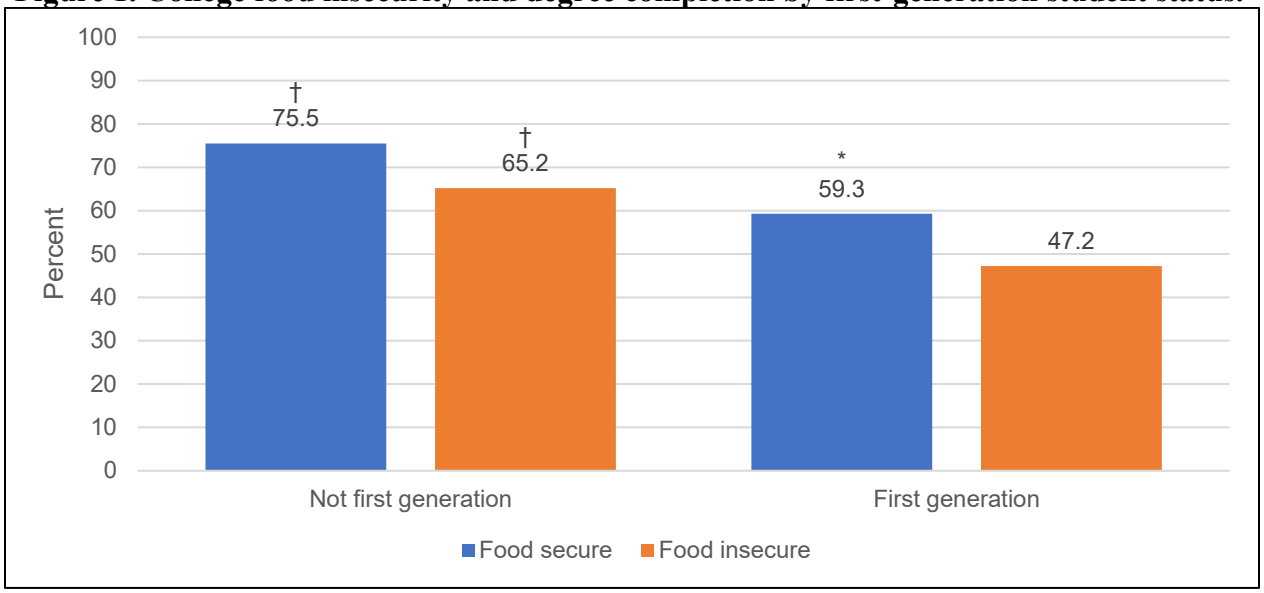
	Model 1			Model 2		
	OR	95% CI	*P-Value*	OR	95% CI	*P-Value*
College degree completion						
Yes	**0.46**	**0.30, 0.70**	***0.001***	0.57	**0.37, 0.88**	***0.013***
Highest degree achieved*	RRR	95% CI	*P-Value*	RRR	95% CI	*P-Value*
Associate's degree	0.66	0.31, 1.42	*0.281*	0.63	0.30, 1.33	*0.220*
Bachelor's degree	**0.45**	**0.30, 0.69**	***<0.001***	0.57	**0.35, 0.92**	***0.022***
Graduate/ professional degree	**0.25**	**0.12, 0.55**	***0.001***	0.39	**0.17, 0.86**	***0.022***
First-generation status						
College degree completion	OR	95% CI	*P-Value*	OR	95% CI	*P-Value*
Yes	-	-	-	**0.44**	**0.31, 0.62**	***<0.001***
Highest degree achieved*	RRR	95% CI	*P-Value*	RRR	95% CI	*P-Value*
Associate's degree	-	-	-	1.11	0.69, 1.89	*0.601*
Bachelor's degree	-	-	-	**0.43**	**0.29, 0.62**	***<0.001***

Graduate/ professional degree	-	-	-	**0.21**	**0.13, 0.35**	***<0.001***

Model 1: Logit (for degree completion) and Multinomial Logit (for degree type) models adjusted for age, sex, race/ethnicity, and household position
Model 2: Logit (for degree completion) and Multinomial Logit (for degree type) models adjusted for Model 1 covariates plus first-generation students status and income to needs ratio
Food insecurity defined as marginal, low and very low food security status
*15 individuals are missing degree information

The predicted probability of college degree completion based on multivariate-adjusted models with an interaction between food security and first-generation status is shown in **Figure 1**. Less than half of first-generation students who experienced food insecurity during college graduated from college (47.2%). Among first-generation students, food-insecure students had significantly lower odds of college completion (47.2% vs. 59.3%, *P=0.02*). First-generation students experiencing food insecurity were also more likely than non-first-generation students experiencing food insecurity to not complete college (47.2% vs. 65.2%, *P=0.037*). Among students who were not first-generation, food security status was not significantly associated with differences in college completion.

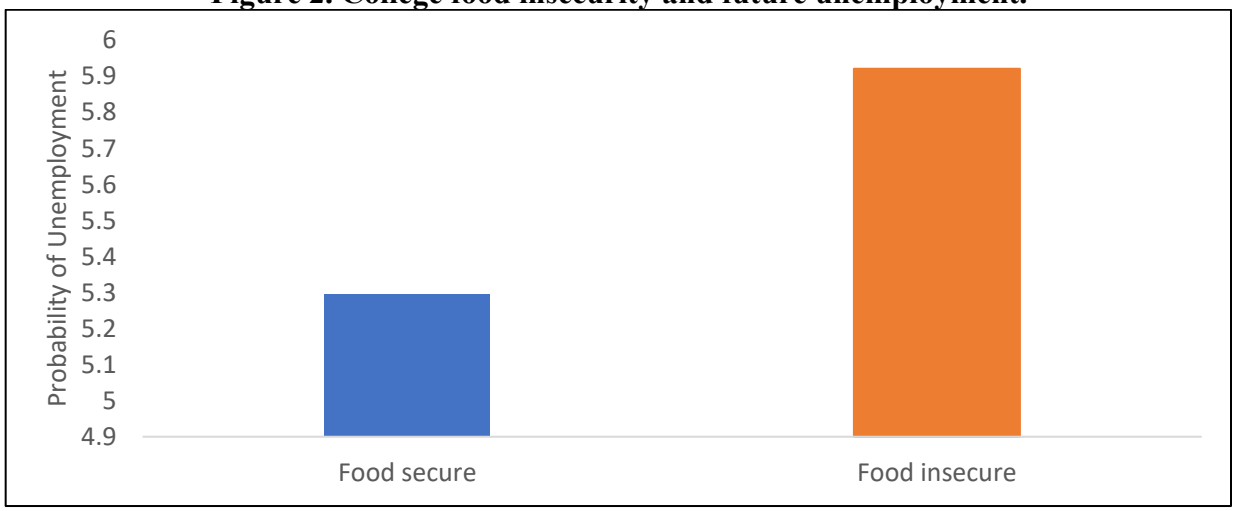
Figure 1. College food insecurity and degree completion by first-generation student status.



Note: Post estimation margins from the interaction between food security and first-generation status from a logit model including an interaction between food security status and first-generation status adjusted for household position, age, sex, race, and income to needs ratio.
*Differences between food-secure and food-insecure (within first-generation status) significant at p<0.05
†Differences between first-generation status (within food security status) significant at p<0.05

The association between college food insecurity and future unemployment is shown in **Figure 2**. Across each PSID survey wave from 2005-2019, the predicted probability of being unemployed was 5.3% for food-secure individuals and 5.9% for food-insecure individuals, after adjustment for all study covariates and whether the individual received a college degree. This difference was not statistically significant (*P=0.49*).

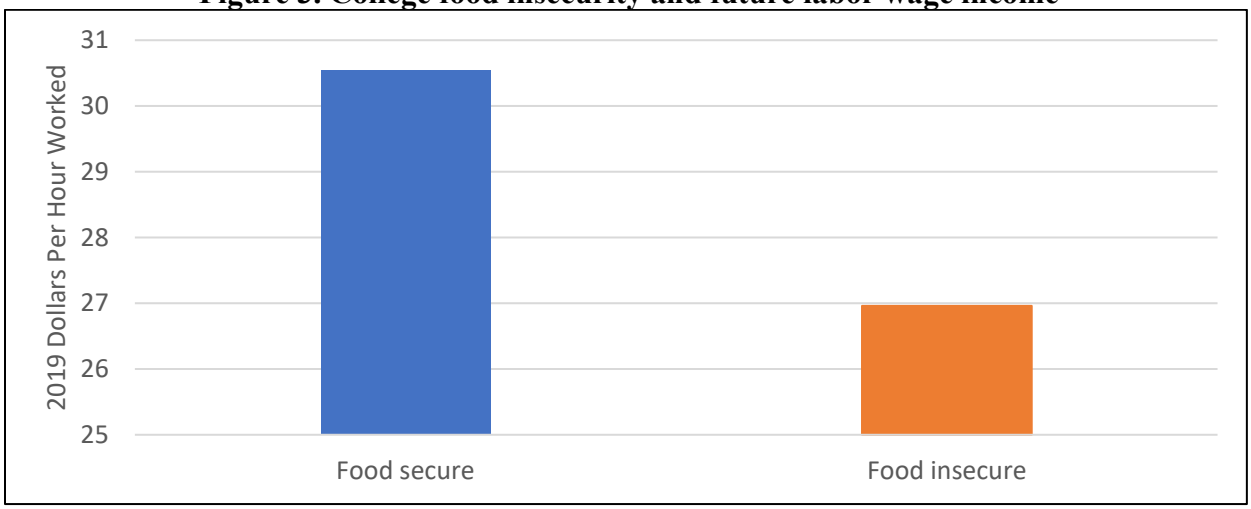
Figure 2. College food insecurity and future unemployment.



<u>Aim 2</u>: Examine how college food insecurity affects future labor income and wealth accumulation.

Figure 3 presents multivariate- adjusted mean labor wage income for individuals who were working part-time or full-time using data from 2005-2019. After adjustment for all sociodemographic characteristics and whether they received a college degree, the predicted mean labor wage income for food-secure individuals was $30.54 and the predicted mean labor wage income for food-insecure individuals was $26.96 (in 2019 dollars) (*P=0.002*).

Figure 3. College food insecurity and future labor wage income



Due to the right skew of labor wage, the log of labor wage was also considered. As seen in **Figure 4**, in the multivariate adjusted models the difference in the predicted mean labor wage is persistent and generally increasing over time, from 14.8% in 2005 to 19.8% in 2019. Here we are able to consider the year by year changes, analyzing individuals with a non-zero value of average labor income by their college food security status. We see that the average labor wage for those who were food-insecure during college is significantly lower than those who were secure.

Figure 4. College food insecurity and yearly labor wage difference (food-secure vs. food-insecure)

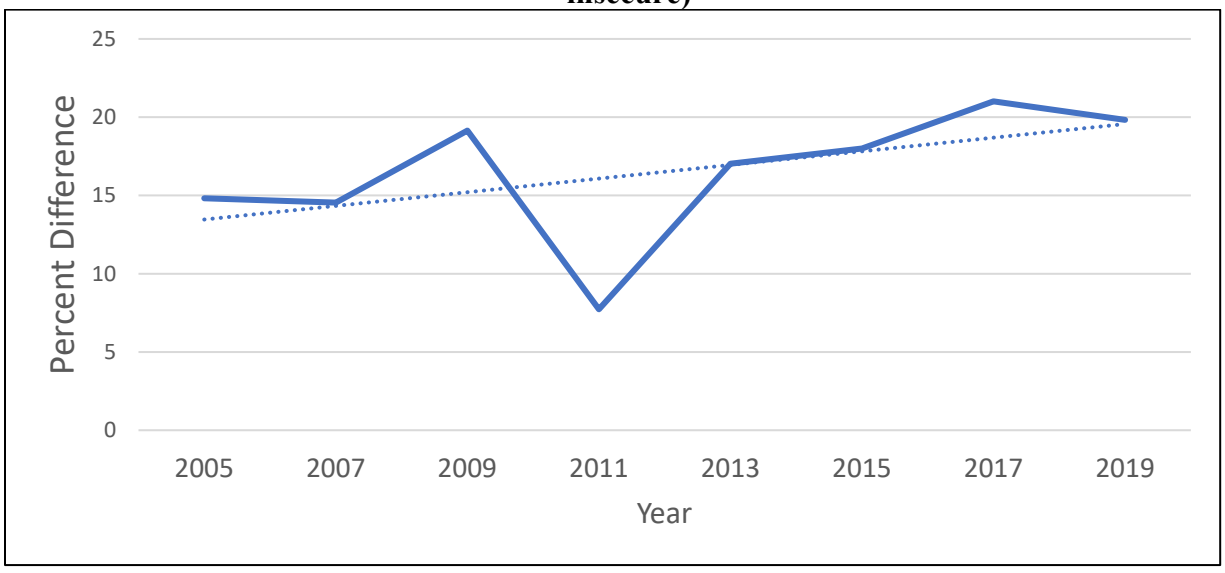


Table 3 shows the association between college food insecurity and future family wealth with and without home equity. Considering family wealth without home equity across all waves from 2005-2019, college food insecurity was associated with $52,621 lower wealth (in 2019 dollars) after adjusting for sociodemographic characteristics. This association was attenuated after further adjustment for income to needs ratio and whether they received a college degree. Considering family wealth with home equity, college food insecurity was associated with $74,793 lower wealth overall (in 2019 dollars) after adjusting or sociodemographic characteristics. After further adjustment for income to needs ratio and whether they received a college degree, college food insecurity remained significantly inversely associated with family wealth including home equity.

Table 3. College food insecurity and future wealth accumulation

	Mean difference	SE
Family wealth (without home equity)		
Unadjusted	-76,169***	15,344
Adjusted for age, sex, race, household position, marital status, and presence of child	-52,621***	15,919
Adjusted for all covariates, income to needs ratio, and whether they received college degree	-25,276	15,640
Family wealth (with home equity)		
Unadjusted	-108,675***	16,895
Adjusted for age, sex, race, household position, marital status, and presence of child	-74,793***	16,991
Adjusted for all covariates, income to needs ratio, and whether they received college degree	-40,076**	17,135

***P<0.05; ***P<0.01*

Predicted future wealth by college food security status by year is shown in **Figures 5 and 6**. Not including home equity (**Figure 5**), the difference in wealth by food security status in college becomes significant from 2015 forward and is widening over time (*P<0.05 for 2015, P<0.01 for 2017 and 2019*). Including home equity (**Figure 6**), the difference in wealth of

college food-secure individuals versus college food-insecure becomes significant from 2015 forward and is widening over time (P<0.01). These models are fully adjusted, including all socioeconomic, demographic and college degree completion covariates.

Figure 5. Future wealth (without home equity) by college food insecurity

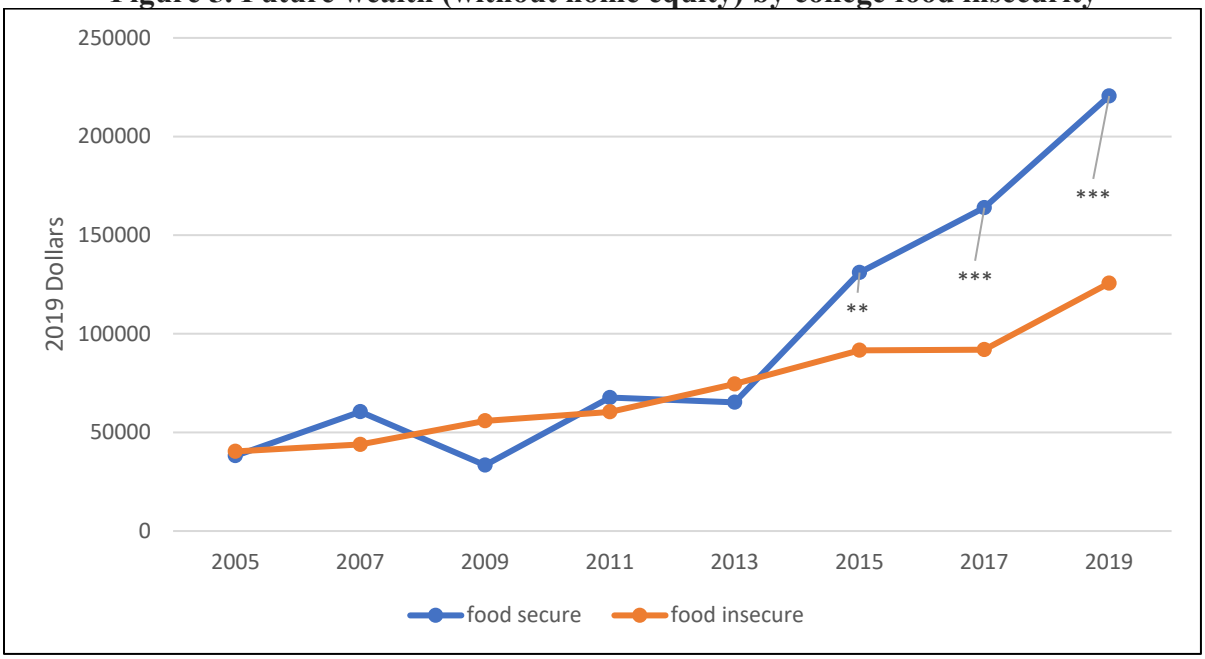
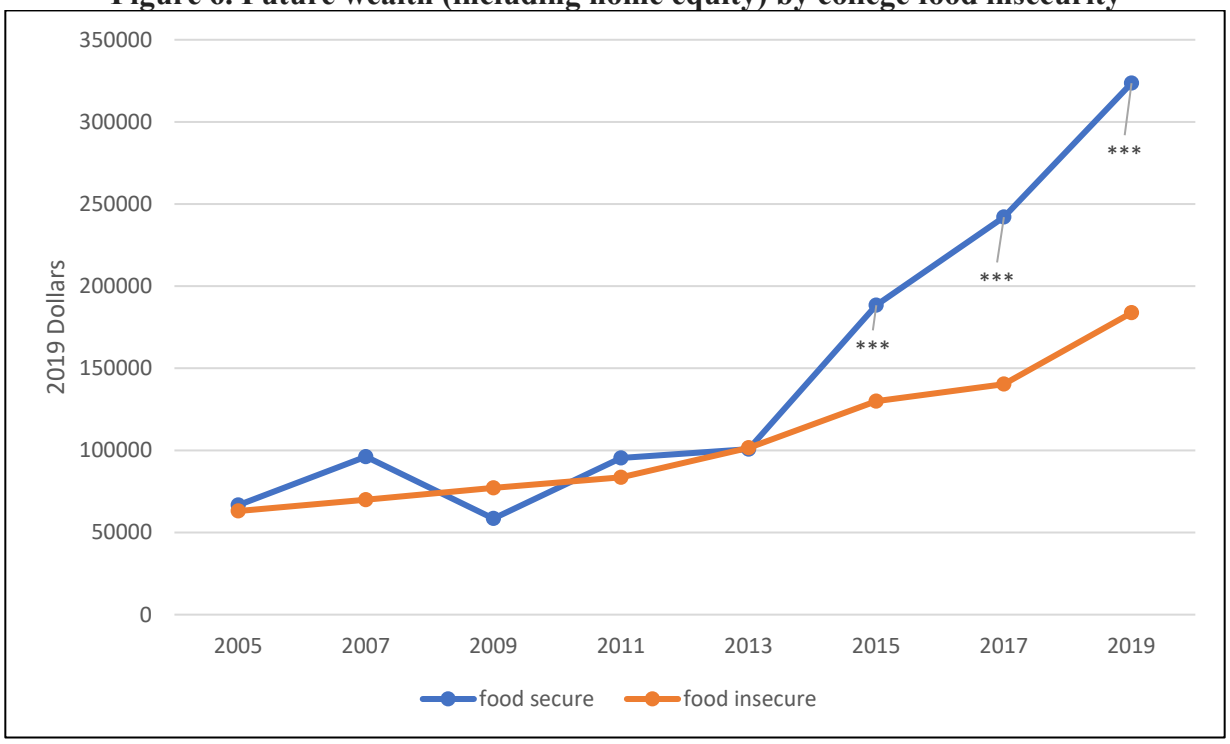


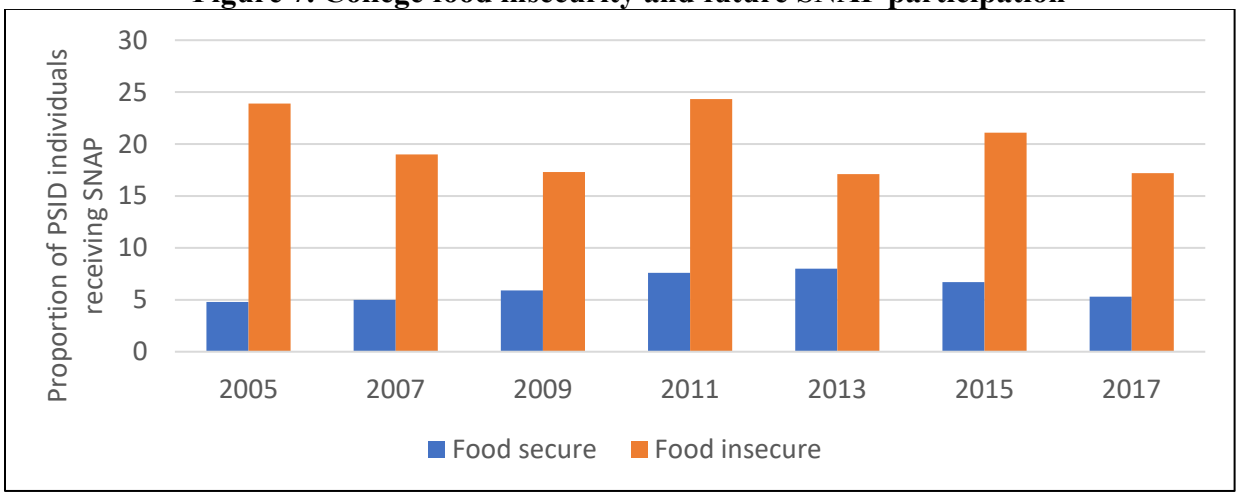
Figure 6. Future wealth (including home equity) by college food insecurity



<u>Aim 3</u>: College food insecurity and future food insecurity and SNAP participation.

The proportion of PSID individuals receiving SNAP from 2005-2017 by food security status is shown in **Figure 7**. Between 2005 and 2017, SNAP participation among individuals who were food-secure in college ranged from 4.8% to 8.0%. SNAP participation among individuals who were food-insecure in college ranged from 17.1% to 24.3%. Individuals who were food-insecure in college were significantly more likely to participate in SNAP at each survey wave than individuals who were food-secure in college (*Ps<0.0001*).

Figure 7. College food insecurity and future SNAP participation



The overall prevalence of adult food insecurity (measured in 2015-17) was 19.9%. Bivariate analyses showed that 40.5% of individuals who were food-insecure in college experienced food insecurity in early to middle adulthood, compared to 16.3% of individuals who were food-secure in college (*P<0.001*).

Table 4 shows the results for the association between college food insecurity and adult food insecurity, stratified by economic independence during college. Adjusting for sociodemographic characteristics, college food insecurity was associated with 45% higher prevalence of food insecurity in adulthood (PR 1.45, 95% CI: 1.16, 1.81). The association between college food insecurity and adult food insecurity was more pronounced among students

who were economically independent from their parents during college (PR 2.23, 95% CI: 1.27, 3.90). This association was attenuated among students who were economically dependent during college (PR: 1.19, 95% CI: 0.86, 1.64).

Table 4. College food insecurity and adult food insecurity

	All PSID participants		Economically independent during college (n=301)		Economically dependent on parents during college (n=1207)	
	PR[a]	95% CI	PR[a]	95% CI	PR[a]	95% CI
College food insecurity						
Food-secure	Ref.		Ref.		Ref.	
Food-insecure	1.45	1.16, 1.81	2.23	1.27, 3.90	1.19	0.86, 1.64

PR, prevalence ratio
[a]Models adjusted for age, income to needs ratio, sex, race/ethnicity, parental education attainment, economic independence (except in stratified models), and childhood participation in the Supplemental Nutrition Assistance Program

DISCUSSION

In this project, we examined the long-term effects of college students' food insecurity on future socioeconomic status, wealth, and food insecurity using nationally representative data from the Panel Study of Income Dynamics. To our knowledge, this is the first project to examine the effects of food insecurity during college on outcomes assessed in early to middle adulthood using prospective data.

First, our results showed that experiencing food insecurity during college is associated with lower odds of college completion, particularly for food-insecure students who are also first-generation college students. Food-insecure students who do graduate are more likely to receive an Associate's degree, and are less likely to receive a Bachelor's degree or graduate/professional degree than their food-secure counterparts. This association may be mediated by: 1) worrying about not having enough to eat or other experiences of food insecurity is a distraction for students, preventing them from focusing on their studies, leading to lower academic performance; 2) food insecurity increases psychological distress, including feelings of shame,

stigma, not belonging, and not feeling supported; and 3) food-insecure students work longer hours for pay to support their basic needs, leaving them less time to focus on their academic and professional development.[2,11,20,21] Given the importance of a college degree for upward social and economic mobility, these findings underscore an important facet of the lasting negative impact of experiencing food insecurity during college, particularly for first-generation students who already face substantial obstacles to graduating from college.[22,23]

Second, our results showed that food insecurity during college was associated with lower mean labor wage income in the years following college attendance – a difference of $3.58 per hour worked. This disparity was further magnified when examining total family wealth. Students who were food-insecure in college would go on to have, on average, $52,621 lower wealth not including home equity and $74,793 lower wealth including home equity (in 2019 dollars). Further, when considering the longitudinal nature of the differences we see that the wealth differences with and without home equity are growing over time in absolute terms and in terms of statistical significance. This analysis is only possible with the use of long-term panel analyses.

Finally, our results showed that college food insecurity was associated with a higher prevalence of food insecurity in the later adult years, particularly among students who were economically independent during college. There are two potential explanations for this association. One is that college food insecurity is associated with greater academic disruption leading to more erratic employment patterns in the future and lower earnings, as we showed in the results of Aims 1 and 2 and corroborated by prior studies.[11,21,24] Two is that college food insecurity may be associated with social exclusion,[25,26] which has implications for one's ability to develop social networks that persist beyond the college years. These results are concerning

given the rising trends in economic independence and food insecurity among college students today,[1,4] and the documented health consequences of food insecurity in adulthood.[27]

The Supplemental Nutrition Assistance Program (SNAP) is the largest federal nutrition assistance program in the U.S. and our nation's safety net against food insecurity. By providing resources to purchase food, SNAP has been shown to improve food security among program participants.[28] However, SNAP also has numerous requirements for participation that has limited its accessibility for college students. Furthermore, SNAP participation rates have been historically low among SNAP-eligible college students, in part due to lack of awareness of program eligibility. In 2019, a Government Accountability Office report identified almost 2 million at-risk college students who were eligible for SNAP and did not report receiving benefits.[4] Continuing outreach and improving communication about college students' SNAP eligibility requirements is important and would complement institutional efforts to create on-campus food pantries to address food insecurity in the short term.

Strengths and Limitations

The strengths of this study include the prospective collection, longitudinal nature, and national representativeness of the sample. There are also some limitations. First, for individuals who were not head/reference person or spouse/partner of their own household while in college (i.e. economically independent from their parents), their college food security measurement was completed by their parent and may not reflect their own food security status. This indirect measure of food insecurity may not be an accurate representation of the student's food security status in college. Second, no measures of food security were collected between 2005-2013, precluding the examination of patterns of food insecurity immediately after college. In addition,

the demographics of college students in this sample may not be representative of the current college population. Given substantial increases in college tuition and expansion of college access to lower-income students during these years, this may partially explain why we observed a lower prevalence of college food insecurity in the present analyses as compared to more recent studies [1,2]. Finally, it has been disputed that the widely accepted HFSSM may not accurately capture the behaviors and experiences related to food insecurity of college students [29]. The measure used in this study has performed well among college students in comparison to other measures of food insecurity [30]. However, qualitative studies are needed to capture the unique experiences of food insecurity among college students, and studies that examine the psychometric properties of commonly used food security assessment tools among college students are needed to inform best practices for food security measurement in this demographic.

Deliverables and Next Steps

We have prepared two manuscripts for publication from this project that are currently under review at the *American Journal of Preventive Medicine* and *Public Health Nutrition*. These manuscripts focus on the outcomes of future food security and educational attainment, respectively. We are currently preparing the manuscript to report the labor income/ future wealth accumulation outcome findings and are continuing to refine the analytic plan for the analysis of outcomes pertaining to unemployment and the Duncan's Socioeconomic Index as another potential outcome and identifying sub-groups of interest (i.e. first-generation college students, economically independent college students) similar to the other Aims. We will prepare two additional manuscripts describing these results in 2021.

CONCLUSION

In this report, we present results from our project examining the long-term effects of experiencing food insecurity during the college years on future socioeconomic status, wealth, and food insecurity. To date, our results show that experiencing college food insecurity, particularly among first-generation students, is associated with lower rates of college graduation and lower degree attainment. College food insecurity is also associated with lower labor income and lower total family wealth including home equity, on average. Finally, experiencing food insecurity during college is associated with a higher prevalence of experiencing food insecurity in early to middle adulthood, predominantly among students who were economically independent during college. These findings underscore the need for policy interventions to alleviate food insecurity during the critical college years and potentially break the cycle of chronic food insecurity and poverty over the life course.

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