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RESEARCH
Research Brief

Food Insecurity and Less Frequent Cooking Dinner at Home Are Associated with Lower Diet Quality in a National Sample of Low-Income Adults in the United States during the Initial Months of the Coronavirus Disease 2019 Pandemic

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ABSTRACT

Background Food insecurity is a critical public health problem in the United States that has been associated with poor diet quality. Cooking dinner more frequently is associated with better diet quality.

Objective This study aimed to examine how food insecurity and dinner cooking frequency are associated with diet quality during the initial months of the coronavirus disease 2019 pandemic.

Design This cross-sectional study analyzed data from a national web-based survey (June 23 to July 1, 2020).

Participants/setting Participants were 1,739 low-income (<250% of the federal poverty level) adults in the United States.

Main outcome measures The outcome was diet quality, measured by the Prime Diet Quality Score (PDQS-30D). The PDQS-30D is a food frequency questionnaire-based, 22-component diet quality index.

Statistical analyses performed Food security status (high, marginal, low, or very low) and frequency of cooking dinner (7, 5 to 6, 3 to 4, or 0 to 2 times/week) were evaluated in relation to PDQS-30D scores (possible range = zero to 126) in age- and sex and gender-, and fully adjusted linear regression models. Postestimation margins were used to predict mean PDQS-30D score by food security status and dinner cooking frequency. The interaction between food security status and frequency of cooking dinner was also tested.

Results Overall, the mean PDQS-30D score was 51.9 ± 11 points (possible range = zero to 126). The prevalence of food insecurity (low/very low) was 43%, 37% of the sample cooked 7 times/week and 15% cooked 0 to 2 times/week. Lower food security and less frequent cooking dinner were both associated with lower diet quality. Very low food security was associated with a 3.2-point lower PDQS-30D score (95% CI −4.6 to −1.8) compared with those with high food security. Cooking dinner 0 to 2 times/week was associated with a 4.4-point lower PDQS-30D score (95% CI −6.0 to −2.8) compared with cooking 7 times/week. The relationship between food insecurity and diet quality did not differ based on cooking dinner frequency.

Conclusions During the initial months of the coronavirus disease 2019 pandemic food insecurity and less frequently cooking dinner at home were both associated with lower diet quality among low-income Americans. More research is needed to identify and address barriers to low-income households' ability to access, afford and prepare enough nutritious food for a healthy diet.
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FOOD INSECURITY, A CONDITION OF LIMITED OR UNcertain access to sufficient and nutritionally adequate food, is a critical public health problem in the United States that contributes to poor diet quality and other health disparities.[1-5] In 2019, approximately 10.5% (or 13.7 million) US households experienced food insecurity[6]; however, in the early months of the coronavirus disease 2019 (COVID-19) pandemic approximately one-quarter to

one-third of all Americans, and 44% of low-income Americans, were estimated to experience food insecurity.[7-9] If accompanied by reductions in diet quality, as has been previously documented,[2,3] food insecurity during the pandemic, particularly among low-income Americans, may contribute to long-lasting health consequences among groups that have been historically economically and socially marginalized.[1,6,10]

During the initial months of the COVID-19 pandemic, early reports indicated that food insecurity rose due to economic disruptions related to the pandemic.[7,10,11] However, annual estimates of food insecurity from the US Department of Agriculture using the Current Population Survey Food Security Supplement indicate that the overall level of food insecurity remained stable in 2020 compared with 2019 though disparities in food security rates did widen for some groups.[12] Questions arose about whether or not more people staying home would lead to improvements in diet quality due to more frequent cooking at home and less frequent eating out.[13] Prior evidence suggests that cooking at home is associated with better diet quality,[14-17] but that diet quality is lower among low-income groups even when they cook frequently.[18] During the pandemic, the limited emerging evidence regarding the relationship between food insecurity, cooking frequency, and diet quality has been mixed.[19-24] Food insecurity has been associated with lower fruit and vegetable consumption,[23] higher energy intake,[22] and lower diet quality.[21] In a cohort study, diet quality and food security status improved compared with prepandemic levels, and eating out frequency decreased.[19] In a cross-country comparisons from June 2020, the United States had the least change in cooking frequency compared to other countries and all countries saw no significant change in fruit or vegetable consumption compared with prepandemic levels.[20] No study during the COVID-19 pandemic has examined the relationships between food insecurity, cooking frequency, and diet quality, which all could have been affected by the societal, economic, and supply chain disruptions during the early months of the pandemic.[20,25,26]

The objective of this study was to examine how food insecurity and frequency of cooking dinner were associated with diet quality during the initial months of the COVID-19 pandemic among a large sample of low-income adults in the United States. A second objective was to examine whether or not dinner cooking frequency modified the relationship between food security status and diet quality. Food insecurity was hypothesized to be associated with lower diet quality and cooking dinner more frequently at home was hypothesized to be associated with better diet quality, particularly among food-secure adults.

RESEARCH SNAPSHOT

Research Question: How were food insecurity and frequency of cooking dinner associated with diet quality during the initial months of the coronavirus disease 2019 pandemic among low-income adults in the United States?

Key Findings: In this large, national survey of low-income adults in the United States, overall diet quality was poor. Food insecurity and frequency of cooking dinner were independently associated with lower diet quality. The relationship between food insecurity and diet quality did not differ based on frequency of cooking dinner.

METHODS

This cross-sectional study analyzed data from a web-based survey, designed using Qualtrics software,[27] to assess food choices and behaviors, food security, and health during the initial months of the COVID-19 pandemic. Developed by the study investigators, the survey included previously validated measures wherever possible (eg, food security status,[12] food agency,[28] diet quality,[29,30] cooking behavior,[31] anxiety and depression,[32] and diabetes distress[33]), and was pilot tested for clarity before rollout. The survey was fielded using CloudResearch, formerly TurkPrime, an online crowdsourcing platform designed to be used for academic research across multiple disciplines.[34] The survey was fielded on Prime Panels. Prime Panels aggregates several market research panels and allows researchers to employ census matching and other targeted recruitment strategies to enable large samples that are more representative of the US population than microtask sites such as MTurk.[35] This study used a census-matched panel of US adults aged 18 years or older (matched on age, sex, and race and ethnicity to the overall population) while also limiting the sample to adults with annual household income <250% of the 2020 federal poverty level (based on household size and annual household income).[36]

The survey was open to participants from June 23, 2020, to July 1, 2020, via an advertisement inviting eligible Prime Panel members to complete the survey. The survey opportunity was displayed to potential participants using a generic survey name (eg, "New Survey Opportunity" or "New Survey"). Data collection was ongoing until the target sample size for all demographic targets was reached. Participants provided informed consent at the start of the survey after reading a brief description of the survey. The survey was described as "a research study assessing your experience and views during a COVID-19 outbreak. The purpose of the study is to understand the effect of the outbreak on the health and wellbeing of adults in the United States." Participants who completed the survey received a small monetary compensation set by the survey platform through which they were recruited. In total, 2,307 complete survey responses were received. Participants who indicated they did not live in the United States (n = 2), completed the survey unrealistically quickly (<10 minutes) (n = 240), were missing information on food security status (n = 17) or who failed to answer attention check questions correctly (n = 309) were excluded resulting in a final analytic sample of 1,739. The final sample included participants in all 50 states and the District of Columbia, and American citizenship was not a requirement to participate (citizenship was not measured). This study was determined to be exempt by the University of Michigan School of Public Health Institutional Review Board.

Measures

Diet quality, as measured by the Prime Diet Quality Score 30-day screener (PDQS-30D) was the outcome for all analyses.[29] A 24-hour recall period and a 30-day recall period version of the PDQS exist; the 30-day version was used for this survey.

The PDQS-30D is a food-based diet quality index that includes 22 components (14 healthy, seven unhealthy, and one neutral in a high-income country setting).[29] The PDQS-30D measures frequency of intake of the 22 component foods/food groups over the past 30 days via a food frequency questionnaire with seven possible responses for each component: less than once/month, 2 to 3 times/month, 1 to 2 times/week, 3 to 4 times/week, 5 to 6 times/week, once a day, or 2 or more times/day.[29] Responses are coded from zero to six with unhealthy components scored in reverse and the neutral component not scored. Scores are then summed to create a PDQS-30D total diet quality score (possible score zero to 126) with higher scores indicating a healthier diet. More information about the development and validation of the PDQS diet quality index and its associated data collection tool (PDQS-30D) is available elsewhere.[29,37,38] Briefly, the PDQS-30D was developed to be used as a short-form screener and global diet quality assessment tool and has been shown to be strongly correlated with usual nutrient intakes as measured by the Automated Self-Administered 24-hour (ASA24) Dietary Assessment Tool,[29] and compares favorably with the Healthy Eating Index-2015.[29,30] In the PDQS-30D validation study there was a statistically significant association between total Healthy Eating Index-2015 score and PDQS-30D score ($r = 0.60$) as well as generally consistent results comparing PDQS-30D results with usual nutrient intakes as measured by the ASA24.[29]

Household food security during the past 30 days was measured using the 18-item US Household Food Security Survey Module.[39] Questions were ordered by severity and included three levels of screening for adults and one additional level of questions for households with children. Affirmative responses were summed to create a total food security score (out of 10 for household with only adults and out of 18 for households with children). Food security categories (high, marginal, low, and very low) were assigned according to the US Department of Agriculture scoring guidelines.[40] Food insecurity refers to both categories of low and very low food security.

Household frequency of cooking dinner was based on the question "In the past 7 days, how many days did you or someone else cook food for dinner or supper at home?" This question was based on the cooking frequency measure included in the 2007-2010 National Health and Nutrition Examination Survey and was asked of all survey respondents.[31] Following prior literature,[18] a four category measure of dinner cooking frequency was created: 7 days/week, 5 to 6 days/week, 3 to 4 days/week, and 0 to 2 days/week.

Covariates were measured using multiple choice questions and included age (18 to 39 years, 40 to 59 years, and ≥60 years), sex and gender (male, female, or transgender/nonbinary/other), race and ethnicity (non-Hispanic White, non-Hispanic Black, Hispanic, Asian, or other), education (high school degree/GED or less, some college, or college degree or higher), student status (yes or no), marital status (single, married, divorced/separated/widowed, or living with a partner), annual household income (<$35,000 or ≥$35,000), Supplemental Nutrition Assistance Program (SNAP) participation (yes/no), household size (1 to 3 people or ≥4 people), presence of children younger than age 18 years old in the household (yes/no), and employment status (full time, part time, unemployed/looking for work, or out of the labor force).

Analysis

First, descriptive statistics were used to examine mean PDQS-30D scores by each study covariate. Simple linear regressions were used to evaluate unadjusted differences in PDQS-30D scores across sample characteristics. Then, associations of food security status and dinner cooking frequency with PDQS-30D scores were examined in age- and sex and gender-adjusted linear regression models. Next, separate linear regression models for food security and dinner cooking frequency adjusted for the full set of covariates described above were used to calculate predicted PDQS-30D scores while holding all other covariates at their means. Trend tests across categories of food security status and dinner cooking frequency were calculated using Stata's contrast command. Finally, differences in the association of food security with diet quality by frequency of cooking dinner was investigated by including an interaction term (the product of categorical variables for food security and cooking dinner frequency) in the fully adjusted model. The significance of the interaction was tested using a likelihood ratio test. In addition, to account for the ordinal nature of the food security and cooking frequency variables, a likelihood ratio test with one degree of freedom using the 'c.' prefix in Stata for both measures was also estimated. All analyses were conducted in Stata version 15.0,[41] all tests were two-sided and significance was considered at $P < 0.05$.

RESULTS

Characteristics of the study sample and unadjusted mean PDQS-30D scores across socio-demographic characteristics are presented in Table 1. The mean PDQS-30D score was 51.9 ± 11.4 points (of possible 0 to 126 points). Compared with non-Hispanic White participants, Hispanic participants (53.2 ± 11.3 vs 50.8 ± 11.1; $P = 0.002$) and Asian participants (58.2 ± 12.0 vs 50.8 ± 11.1; $P < 0.0001$) had higher PDQS-30D scores. Higher educational attainment (some college [$P = 0.001$] and college degree or higher [$P < 0.0001$]) and higher income was also associated with higher PDQS-30D scores ($P < 0.0001$).

Overall, 41.5% of the sample experienced high food security (Table 1). In bivariate associations, those with high food security had the highest PDQS-30D score (53.4 ± 12.2) across all food security levels. Individuals experiencing food insecurity comprised 43.2% of the sample (17.4% low food security and 25.8% very low food security) and had lower PDQS-30D scores compared with those with high food security (low vs high: 51.7 ± 10.5 vs 53.4 ± 12.2; $P = 0.028$; very low vs high: 49.6 ± 10.1 vs 53.4 ± 12.2; $P < 0.0001$). More than one-third (36.6%) of low-income Americans cooked dinner 7 times/week and had the highest PDQS-30D scores (53.9 ± 12.2) compared with less frequent cooks. The least frequent cooks (0 to 2 times/week) had the lowest mean PDQS-30D score (49.2 ± 11.5; $P < 0.0001$ [difference from cooking dinner 7 times/week]).

Age- and sex and gender-adjusted associations between food security status and diet quality (PDQS-30D score) are presented in Table 2. Greater food insecurity was associated with worse PDQS-30D score (P for trend < 0.0001). Compared with individuals with high food security, low food security ($\beta = -1.7$, 95% CI −3.2 to −0.1) and very low food security ($\beta = -3.9$, 95% CI −5.3 to −2.5) were both significantly associated with lower diet quality. These associations

Table 1. Characteristics and unadjusted diet quality score (Prime Diet Quality Screener [PDQS-30D]) of the sample of low-income adults in the United States between June 23 and July 1, 2020 (N = 1,739)

			PDQS-30D				
	n	%	Mean	SD	Min[a]	Max[a]	*P* value[b]
Total	1,739	100	51.9	11.4	21	97	N/A[c]
Sex and gender[d]							
Male	838	48.2	52.2	11.5	24	97	Ref[e]
Female	885	50.9	51.6	11.1	21	92	0.232
Transgender/non-binary/other	16	0.9	54.5	16.7	34	90	0.430
Age (y)							
18-39	790	45.4	52.4	11.4	24	97	Ref
40-59	493	28.4	50.3	11.2	21	97	0.001
60+	456	26.2	52.9	11.4	25	92	0.491
Race and ethnicity							
Non-Hispanic White	1,109	63.8	50.8	11.1	21	92	Ref
Non-Hispanic Black	193	11.1	52.3	10.8	28	97	0.092
Hispanic	250	14.4	53.2	11.3	30	88	0.002
Asian	114	6.6	58.2	12.0	29	97	< 0.0001
Other[f]	73	4.2	53.8	12.7	33	92	0.043
Education							
High school, GED or less	561	32.3	49.5	10.6	24	84	Ref
Some college	583	33.5	51.7	11.5	25	97	0.001
College degree or higher	595	34.2	54.4	11.4	21	97	< 0.0001
Employment							
Full time	470	27.0	52.4	11.1	21	97	Ref
Part time	242	13.9	52.8	10.7	27	88	0.647
Unemployed, looking for work	285	16.4	51.7	11.6	29	97	0.434
Out of the labor force	742	42.7	51.5	11.6	21	92	0.189
College student							
Yes	111	6.4	53.	11.	29	87	0.083
No	1,628	93.6	51.8	11.3	21	97	Ref
Annual household income							
<$35,000	1,055	60.7	50.5	11.4	21	92	Ref
≥$35,000	684	39.3	54.1	10.9	26	97	< 0.0001
SNAP participation							
Yes	522	30.0	49.5	10.4	21	84	< 0.0001
No	1,217	70.0	53.0	11.6	21	97	Ref
Marital status							
Single	664	38.3	51.5	11.9	21	97	Ref
Married	534	30.8	53.6	11.4	27	97	0.002
Divorced, separated, widowed	352	20.3	51.3	10.7	21	85	0.846
Living with a partner	184	10.6	50.0	10.0	27	78	0.116

(*continued on next page*)

Table 1. Characteristics and unadjusted diet quality score (Prime Diet Quality Screener [PDQS-30D]) of the sample of low-income adults in the United States between June 23 and July 1, 2020 (N = 1,739) (*continued*)

			PDQS-30D				
	n	%	Mean	SD	Min[a]	Max[a]	*P* value[b]
Household size							
1-3 people	1,272	73.2	51.4	11.4	21	97	Ref
4 or more people	467	26.9	53.4	11.1	24	97	0.001
Children younger than 18 years in household							
Yes	523	30.1	53.5	11.0	24	97	Ref
No	1,216	69.9	51.3	11.4	21	92	< 0.0001
Food security status							
High	722	41.5	53.4	12.2	21	97	Ref
Marginal	266	15.3	52.3	11.4	26	87	0.183
Low	302	17.4	51.7	10.5	21	82	0.028
Very low	449	25.8	49.6	10.1	25	97	< 0.0001
Cooking dinner frequency (times/wk)							
7	637	36.6	53.9	12.2	21	97	Ref
5-6	510	29.3	52.5	10.4	27	90	0.027
3-4	340	19.6	49.4	9.9	24	97	< 0.0001
0-2	252	14.5	49.2	11.5	21	86	< 0.0001

[a]Possible range of scores for the PDQS-30D is 0 to 126. Higher scores indicate better diet quality.
[b]*P* values from separate simple linear regressions with each categorical variable as the predictor and PDQS-30D score as the outcome.
[c]N/A = not available.
[d]Sex and gender response options were included in the same survey question.
[e]Ref = reference category.
[f]Other race and ethnicity category included Native American (n = 27), Pacific Islander (n = 3), Middle Eastern or North African (n = 8), or participants who entered text in the open response 'Other' category (n = 35). 'Other' included a variety of responses from participants primarily, but not exclusively, indicating multiple identities, including "mixed," "multiethnic," and "multiracial." Text entries also included responses such as "Latin" or "Israelite," "human," or "Lebanese American."

persisted in the fully adjusted models: low food security was associated with a 1.9-point lower PDQS-30D score (95% CI −3.4 to −0.4) and very low food security was associated with a 3.2-point lower PDQS-30D score (95% CI −4.6 to −1.8) compared with high food security.

In age- and sex and gender-adjusted models cooking dinner less frequently was also associated with lower PDQS-30D scores (*P* for trend < 0.0001) (Table 2). Compared with individuals who cooked dinner at home 7 times/week, cooking dinner 5 to 6 times/week ($\beta = -1.5$, 95% CI −2.8 to −0.2), 3 to 4 times/week ($\beta = -4.8$, 95% CI −6.3 to, −3.3), and 0 to 2 times/week ($\beta = -4.8$, 95% CI −6.5 to −3.2) were all significantly associated with lower diet quality. These associations persisted in the fully adjusted models: cooking 0 to 2 times/week was associated with a 4.4-point lower PDQS-30D score (95% CI −6.0 to −2.8) compared with cooking 7 times/week.

In fully adjusted models that mutually adjusted for food security status and cooking dinner frequency, the significant inverse associations with diet quality for both exposures remained but were slightly attenuated (see Table 3, available at www.jandonline.org). However, there was no evidence that the association between food insecurity and PDQS-30D scores differed based on frequency of cooking dinner (effect modification) based on likelihood ratio tests with multiple degrees of freedom or one degree of freedom (*P* values > 0.05) (data not shown).

Differences in the frequency of consumption of PDQS-30D components by food security status are available in Table 4 (available at www.jandonline.org). Lower PDQS-30D scores related to more severe food insecurity were largely accounted for by lower frequency of consumption of several healthy PDQS-30D components (ie, dark green leafy vegetables, cruciferous vegetables, other vegetables, other fruits, nuts and seeds, fish, whole grains, low-fat dairy, and liquid vegetable oils) and higher frequency of consumption of unhealthy PDQS-30D components (ie, processed meats, sugar-sweetened beverages, and fried foods away from home) (all *P* values < 0.05). Similarly, lower diet quality among those who cooked dinner less frequently (see Table 5, available at www.jandonline.org) was accounted for by lower frequency of consumption of all healthy PDQS-30D components (with the exception of fish) and higher frequency of consumption of some unhealthy components (ie, sugar-sweetened beverages and fried foods away from home all *P* values < 0.05).

The Figure displays the predicted mean PDQS-30D scores by food security status (Panel A) and frequency of cooking dinner at home (Panel B) based on separate fully adjusted models. Individuals with high food security were expected to have PDQS-30D scores of 53.2 points, which were

Table 2. Food insecurity and cooking dinner frequency associations with diet quality among low-income adults in the United States between June 23 and July 1, 2020 (N = 1,739)

	Model 1[a]		Model 2[b]	
Variable	β	**95% CI**	β	**95% CI**
Panel A				
Food security status				
High	Ref[c]		Ref	
Marginal	−1.1	−2.7 to 0.5	−0.9	−2.5 to 0.6
Low	−1.7	−3.2 to −0.1	−1.9	−3.4 to −0.4
Very low	−3.9	−5.3 to −2.5	−3.2	−4.6 to −1.8
P for trend[d]	< 0.0001		< 0.0001	
Panel B				
Cooking dinner frequency				
7 times/week	Ref		Ref	
5-6 times/week	−1.5	−2.8 to −0.2	−1.59	−2.9 to −0.3
3-4 times/week	−4.8	−6.3 to −3.3	−4.69	−6.1 to −3.3
0-2 times/week	−4.8	−6.5 to −3.2	−4.42	−6.0 to −2.8
P for trend	< 0.0001		< 0.0001	

[a]Model 1 is an age- and gender-adjusted ordinary least squares regression model (separate models for food security and cooking frequency).
[b]Model 2 is an ordinary least squares model (separate models for food security and cooking frequency) adjusted for age, sex and gender, race and ethnicity, education, income, marital status, household size, presence of children aged younger than 18 years in the household, employment, Supplemental Nutrition Assistance Program participation, and student status.
[c]Ref = reference category.
[d]*P* for trend obtained using the postestimation contrast command in Stata[41] to test whether or not the linear trend across categories is significant.

significantly higher than expected PDQS-30D scores of individuals with low (51.3 points) and very low (50.0 points) food security. Individuals who cooked dinner 7 times/week had the highest expected PDQS-30D scores (54.0 points), which were significantly higher those individuals cooking dinner 5 to 6 times/week (52.4 points), 3 to 4 times/week (49.3 points), and 0 to 2 times/week (49.5 points).

DISCUSSION

In this national survey of low-income Americans during the COVID-19 pandemic results show that overall diet quality was poor (mean scores less than half of the possible PDQS-30D score), and that after adjusting for sociodemographic characteristics, both greater food insecurity and less frequent cooking dinner at home were associated with lower diet quality as measured by the PDQS-30D. Contrary to our hypothesis, the relationship between food insecurity and diet quality did not differ by frequency of cooking dinner; in this sample, food insecurity was associated with lower diet quality regardless of how frequently people cooked dinner. Given the high levels of food insecurity observed during the early months of the pandemic from this study and others,[7-9,42] and the widening disparities documented in US Department of Agriculture annual food security estimates,[12] and prior evidence regarding associations between food insecurity and health,[43-48] findings from this study suggest that adverse diet-related health outcomes may follow.

These findings are consistent with prior evidence showing that food insecurity is associated with poor diet quality, and that these findings are robust across dietary assessment methods and diet quality indexes.[1-4,49-52] PDQS-30D scores were also low for all demographic groups (mean scores were all below 50% of possible scores), which is consistent with prior evidence of poor diet quality among Americans with low income.[53,54] PDQS-30D scores in this sample were also lower than prior estimates among US women (mean score = 56 points).[29] Also consistent with prior research,[2,3,23,51,52] lower diet quality among those experiencing food insecurity was due to lower consumption of some fruits and vegetables, whole grains, and healthy fats; and higher consumption of highly palatable and highly processed foods such as processed meat, fried foods, and sweetened beverages. These known associations between food insecurity and diet quality not only persisted for low-income Americans during the COVID-19 pandemic, but may have also been exacerbated because food-insecure households faced unique challenges in acquiring necessary food items during the early months of the pandemic.[7]

Notably, the mean frequency of cooking dinner (5.0 times/week) in the current study is consistent with the prepandemic mean frequency of cooking dinner as measured in multiple US national samples.[17,55,56] This suggests that although some people may have been cooking more frequently in the early months of the pandemic, on average, overall cooking dinner frequency did not increase. It is also notable that even within a low-income sample, higher cooking dinner frequency was still associated with better diet quality, even after adjusting for sociodemographic measures that contrasts with prior evidence.[18] The fact that the

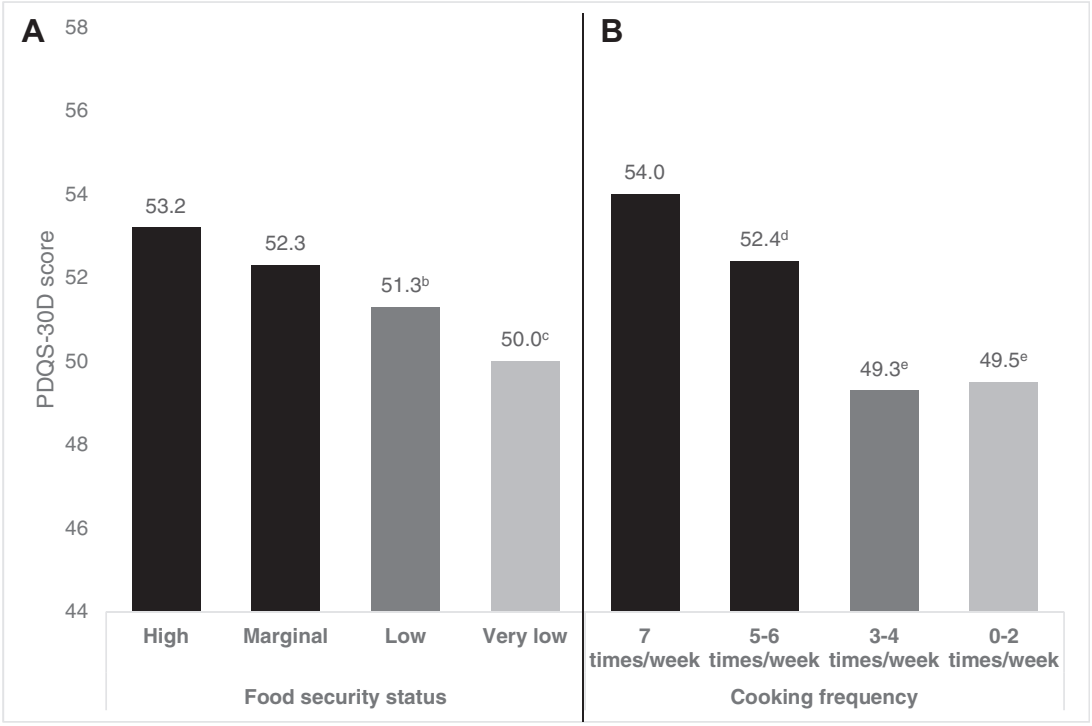

Figure. Predicted mean Prime Diet Quality Screener (PDQS-30D) score[a] by food insecurity (Panel A) and frequency of cooking dinner (Panel B) among low-income adults in the United States between June 23 and July 1, 2020 (N = 1,739). [a]Results from ordinary least squares regression models (separate models for food security and cooking frequency) adjusted for age, sex and gender, race and ethnicity, education, income, marital status, household size, presence of children younger than age 18 years in the household, employment, Supplemental Nutrition Assistance Program participation, and student status. [b]Difference from high food security significant at $P < 0.05$. [c]Difference from high food security significant at $P < 0.001$. [d]Difference from cooking 7 times/week significant at $P < 0.05$. [e]Difference from cooking 7 times/week significant at $P < 0.001$.

relationship between food insecurity and diet quality did not differ by cooking dinner frequency is also striking. Although cooking is a modifiable behavior that can improve diet quality, our findings suggest that other policy interventions are needed to improve food access and availability, both key dimensions of food insecurity,[57,58] to influence diet quality in food-insecure populations.

During the COVID-19 pandemic numerous policy interventions, including stimulus payments and unemployment insurance program expansions, aimed to blunt the economic influence of the pandemic for US households, particularly those at risk for food insecurity.[59-61] SNAP, the largest federal nutrition assistance program, expanded rapidly growing by 17% in the early months of the pandemic.[62] Later Congressional relief bills further modified the program to, among other things, ease enrollment and recertification requirements and increase benefits by 15%.[59-61] The present findings underscore that though those efforts likely contributed to overall estimates of food insecurity remaining stable from 2019 to 2020,[12] many households still experienced food insecurity, which was associated with poor diet quality even when people cooked at home frequently. Due to the positive association between cooking frequency and diet quality, more efforts and continued support is needed to help households at risk for food insecurity both procure and prepare enough nutritious food to support a healthy diet.[63-68] The recent changes to the Thrifty Food Plan, which SNAP benefits are based on, will increase SNAP benefits by 21% and are an important step that may help food insecure households afford the true cost of a healthy diet.[69] It will be important for future research to investigate whether or not/how these benefit increases influence cooking behaviors and diet quality.

Limitations

This study should be considered in light of several limitations. Primarily, the cross-sectional nature of the data precludes making any causal inferences about food insecurity, cooking and diet quality. Measures of prepandemic food security status or cooking frequency were also not included, which precludes examination of pandemic related changes in food security or cooking. Second, all data are self-reported which can lead to social desirability and recall bias.[70] This may be particularly relevant when it comes to the PDQS-30D data. The PDQS-30D requires participants to recall and estimate usual frequency of consumption over the past 30 days, which could be more vulnerable to recall bias than a shorter timeframe or 24-hour recall. Relatedly, selection bias could also be present if Prime Panel members who participated in the survey systematically differed from those who did not participate or from the general population. The use of quotas to match the sample with US Census demographic characteristics mitigates some of this concern (see Table 6, available at www.jand.online), but unmeasured differences could still be present, which could limit generalizability. Another potential limitation related to the survey platform used is

satisficing,[71] in which respondents rush through a survey and do not provide thoughtful or true answers. To address this possibility participants who completed the survey unreasonably quickly or who failed attention checks embedded in the survey were excluded. Furthermore, the survey was fielded with PrimePanels, which employs their own quality checks for participants who are part of the panel. Third, the survey was fielded in English only, and its web-based nature required participants to have Internet access. This could limit the representativeness of the data to some subpopulations that are particularly vulnerable to food insecurity (ie, those with very low incomes, without high school degrees, or without Internet access) and could limit the generalizability of the results to non-English–speaking populations. Fourth, the PDQS-30D is a short form dietary screener that does not fully capture every food or beverage a person could consume, but rather focuses on a limited number of food and beverage groups. However, the PDQS-30D has compared well against an open-ended dietary assessment method, specifically the ASA24.[29] Fifth, the observed differences in dietary quality measured in this study were relatively small and how sustained such differences would be over time or how likely they are to contribute to differences in health outcomes over the long term is unknown. In addition, the way sex was measured in the survey included both biological sex and gender identity response options within the same question, which could have caused confusion among some participants about how to respond. Finally, the cooking frequency measure used in this study focused on only frequency of cooking dinner, rather than other meals, and did not further define what types of food preparation should be included in the definition of cooking, which prior research shows varies considerably and can influence how individuals report how frequently they cook at home.[55,72] Although frequency of cooking dinner was chosen because it is a widely used measure of cooking frequency,[17,31,55,56,73,74] and because, in the United States, dinner is the most frequently cooked meal,[55] it is possible that, particularly during the COVID-19 pandemic, other meals were cooked at home more frequently, which could also influence diet quality. Relatedly, cooking skill levels, motivation for cooking, or other factors that could influence the relationship between cooking frequency and diet quality were not investigated in this study.

CONCLUSIONS

During the COVID-19 pandemic, overall diet quality in this sample of low-income Americans was poor and low food security and less frequent cooking dinner at home were both associated with lower diet quality. However, the relationship between food security and diet quality did not differ based on frequency of cooking dinner, indicating that food insecurity in the present sample was associated with lower diet quality regardless of how frequently people cooked dinner at home. More research is needed to identify and address barriers to low-income households' ability to access, afford, and prepare enough nutritious food for a healthy diet.

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STATEMENT OF POTENTIAL CONFLICT OF INTEREST

No potential conflict of interest was reported by the authors.

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AUTHOR CONTRIBUTIONS

J. Wolfson and C. Leung designed the study and developed and fielded the survey. J. Wolfson and C. Leung developed the study hypotheses. J. Wolfson conducted the analyses and wrote the first draft of the manuscript. All authors critically reviewed and approved the manuscript as submitted.

Table 3. Food security and cooking dinner frequency associations with diet quality among low-income adults in the United States between June 23 and July 1, 2020 (N = 1,739)

	Model 3[a]	
Variable	**β**	**95% CI**
Food security status		
High	Ref[b]	
Marginal	−0.8	−2.3 to 0.7
Low	−1.6	−3.1 to −0.2
Very low	−2.8	−4.1 to −1.4
P for trend[c]	0.0001	
Cooking dinner frequency (times/wk)		
7	Ref	
5-6	−1.7	−2.9 to −0.3
3-4	−4.5	−5.9 to −3.0
0-2	−4.2	−5.8 to −2.6
P for trend[c]	< 0.0001	

[a]Model 3 is an ordinary least squares model that included food insecurity, cooking frequency (both exposures simultaneously in the model), age, sex and gender, race and ethnicity, education, income, marital status, household size, presence of children younger than age 18 years in the household, employment, Supplemental Nutrition Assistance Program participation, and student status.

[b]Ref = reference category.

[c]*P* value for trend obtained by using the postestimation contrast command in Stata[41] to test whether or not the linear trend across categories is significant.

Table 4. Differences in Prime Diet Quality Screener (PDQS-30D) component consumption frequency (%) by food security status among low-income adults in the United States between June 23 and July 1, 2020 (N = 1,739)

	Food Security Status				
Component	High (n = 722)	Marginal (n = 266)	Low (n = 302)	Very Low (n = 449)	*P* value[a]
	←——————————%——————————→				
Healthy					
Dark green leafy vegetables					
≤ once/mo	26.9	27.8	29.5	34.3	< **0.001**
2-3 times/mo	18.1	18.4	22.2	27.2	
1-2 times/wk	24.9	25.9	28.5	18.9	
3-4 times/wk	16.5	15.8	12.6	12.9	
5-6 times/wk	5.8	6.0	4.0	2.9	
Once a day	5.3	4.9	2.7	2.9	
≥2 times/d	2.5	1.1	0.6	0.9	
Cruciferous vegetables					
≤ once/mo	26	29.7	26.5	35.9	**0.002**
2-3 times/mo	21.3	19.9	28.2	23.4	
1-2 times/wk	26.3	24.4	24.2	23.6	
3-4 times/wk	14.8	18.1	12.3	12.3	
5-6 times/wk	5.7	4.1	5.6	2.2	
Once a day	4.7	3.0	3.3	1.8	
≥2 times/d	1.1	0.8	0	0.9	
Deep orange vegetables					
≤ once/mo	35	35.3	36.1	42.1	0.312
2-3 times/mo	24.5	25.9	28.8	26.5	
1-2 times/wk	25.1	25.6	21.2	17.2	
3-4 times/wk	8.3	7.5	8.6	9.6	
5-6 times/wk	4.4	2.6	3.0	2.9	
Once a day	1.8	2.3	1.7	1.3	
≥2 times/d	0.8	0.8	0.7	0.5	
Other vegetables					
≤ once/mo	16.9	19.9	17.6	27.4	<**0.001**
2-3 times/mo	17.0	22.2	25.5	23.2	
1-2 times/wk	28.0	29.7	27.5	23.6	
3-4 times/wk	21.9	18.8	20.5	16.7	
5-6 times/wk	10.7	4.4	6.0	5.6	
Once a day	4.3	3.4	2.0	2.2	
≥2 times/d	1.3	1.9	1.0	1.3	
Citrus fruits					
≤ once/mo	32.7	36.1	26.2	33.6	0.105
2-3 times/mo	22.0	19.6	24.5	28.3	
1-2 times/wk	20.2	21.1	20.5	18.0	
3-4 times/wk	12.5	10.9	16.2	10.7	

(*continued on next page*)

Table 4. Differences in Prime Diet Quality Screener (PDQS-30D) component consumption frequency (%) by food security status among low-income adults in the United States between June 23 and July 1, 2020 (N = 1,739) (*continued*)

	Food Security Status				
Component	High (n = 722)	Marginal (n = 266)	Low (n = 302)	Very Low (n = 449)	*P* value[a]
5-6 times/wk	4.9	4.9	6.6	4.9	
Once a day	6.0	5.3	4.6	2.9	
≥2 times/d	1.8	2.3	1.3	1.6	
Deep orange fruits					
≤ once/mo	58.3	54.5	49.7	56.4	0.472
2-3 times/mo	18.0	22.2	21.5	19.8	
1-2 times/wk	13.6	13.9	15.9	13.1	
3-4 times/wk	6.2	4.9	8.3	5.1	
5-6 times/wk	1.5	1.5	3.0	2.9	
Once a day	1.9	2.3	1.3	1.6	
≥2 times/d	0.4	0.8	0.3	1.1	
Other fruits					
≤ once/mo	16.2	16.9	18.2	24.1	**<0.001**
2-3 times/mo	23.3	25.2	27.5	28.1	
1-2 times/wk	22.0	25.2	23.2	26.7	
3-4 times/wk	18.8	15.8	18.5	13.1	
5-6 times/wk	10.0	7.1	7.6	3.6	
Once a day	7.3	7.9	4.3	2.9	
≥2 times/d	2.4	1.9	0.7	1.6	
Legumes					
≤ once/mo	27.8	22.9	23.5	25.8	0.119
2-3 times/mo	24.8	30.1	27.5	26.7	
1-2 times/wk	26.5	29.7	32.5	22.3	
3-4 times/wk	13.3	10.9	11.6	14.7	
5-6 times/wk	4.7	3.8	3.6	6.0	
Once a day	1.9	1.9	1.3	2.9	
≥2 times/d	1.0	0.8	0	1.6	
Nuts and seeds					
≤ once/mo	30.3	28.2	32.8	42.5	**<0.001**
2-3 times/mo	20.8	27.4	26.2	21.8	
1-2 times/wk	21.2	20.3	22.5	17.8	
3-4 times/wk	13.9	12.0	9.9	11.8	
5-6 times/wk	6.9	6.4	4.3	3.6	
Once a day	6.0	3.4	2.7	1.3	
≥2 times/d	1.0	2.3	1.7	1.1	
Poultry					
≤ once/mo	9.6	11.3	11.3	15.1	0.068
2-3 times/mo	18	16.5	19.9	22.5	
1-2 times/wk	36.1	29.0	30.5	31.2	

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Table 4. Differences in Prime Diet Quality Screener (PDQS-30D) component consumption frequency (%) by food security status among low-income adults in the United States between June 23 and July 1, 2020 (N = 1,739) (*continued*)

	Food Security Status				
Component	High (n = 722)	Marginal (n = 266)	Low (n = 302)	Very Low (n = 449)	*P* value[a]
3-4 times/wk	24.1	29.0	25.8	20.3	
5-6 times/wk	7.8	10.5	8.0	6.9	
Once a day	3.5	3	3.3	2.2	
≥2 times/d	1.1	0.8	1.3	1.8	
Fish					
≤ once/mo	41.1	39.5	40.1	52.3	**<0.001**
2-3 times/mo	26.6	30.8	27.8	22.9	
1-2 times/wk	25.2	22.2	20.2	15.1	
3-4 times/wk	5.1	5.9	8.9	5.4	
5-6 times/wk	1.7	2.6	2.0	2.5	
Once a day	0.3	0	0.7	0.7	
≥2 times/d	0	0	0.3	1.1	
Whole grains					
≤ once/mo	15.7	18.4	15.6	19.2	**0.001**
2-3 times/mo	14.1	14.3	24.5	16.3	
1-2 times/wk	24.2	24.4	23.8	27.6	
3-4 times/wk	19.4	20.3	19.2	19.6	
5-6 times/wk	12.3	13.5	10.3	9.1	
Once a day	11.8	7.1	5.6	5.8	
≥2 times/d	2.5	1.9	1.0	2.5	
Low fat dairy					
≤ once/mo	34.6	35.7	25.5	26.1	**<0.001**
2-3 times/mo	12.3	14.7	16.9	16.7	
1-2 times/wk	13.2	16.2	27.2	23.8	
3-4 times/wk	14.4	12.0	13.6	18.5	
5-6 times/wk	9.8	8.7	7.6	4.9	
Once a day	11.9	9.4	7.3	7.4	
≥2 times/d	3.7	3.4	2.0	2.7	
Liquid vegetable oils					
≤ once/mo	27.6	31.2	23.5	31.6	**0.013**
2-3 times/mo	19.1	17.3	17.6	22.3	
1-2 times/wk	21.5	22.6	28.5	20.5	
3-4 times/wk	14.8	13.2	16.2	14.0	
5-6 times/wk	10.7	6.8	8.6	5.8	
Once a day	4.0	6.4	5.3	4.7	
≥2 times/d	2.4	2.6	0.3	1.1	
UNHEALTHY	%	%	%	%	
Red meat as a main dish					
≤ once/mo	16.2	18.4	22.5	21.6	0.063
2-3 times/mo	21.2	18.1	22.5	24.7	

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Table 4. Differences in Prime Diet Quality Screener (PDQS-30D) component consumption frequency (%) by food security status among low-income adults in the United States between June 23 and July 1, 2020 (N = 1,739) (*continued*)

	Food Security Status				
Component	High (n = 722)	Marginal (n = 266)	Low (n = 302)	Very Low (n = 449)	*P* value[a]
1-2 times/wk	35.2	36.8	29.1	29.6	
3-4 times/wk	20.5	20.3	20.5	16.1	
5-6 times/wk	5.4	4.9	3.0	5.8	
Once a day	1.3	1.5	1.7	1.1	
≥2 times/d	0.3	0	0.7	1.1	
Processed meat					
≤ once/mo	23.8	21.4	20.5	21.4	**0.003**
2-3 times/mo	25.5	27.1	24.8	20.9	
1-2 times/wk	30.6	25.9	33.1	25.6	
3-4 times/wk	14.7	18.4	13.6	19.8	
5-6 times/wk	3.6	4.1	4.6	8.2	
Once a day	1.3	2.6	3.3	2.9	
≥2 times/d	0.6	0.4	0	1.1	
Potatoes					
≤ once/mo	20.5	21.8	21.5	27.6	**0.009**
2-3 times/mo	14.5	16.5	22.2	18.5	
1-2 times/wk	29.0	29.0	27.8	20.7	
3-4 times/wk	24.2	21.8	18.2	22.5	
5-6 times/wk	7.6	7.5	7.3	6.9	
Once a day	3.6	1.5	2.3	2.2	
≥2 times/d	0.6	1.9	0.7	1.6	
Refined grains and baked goods					
≤ once/mo	11.6	12.4	13.6	14.0	**0.025**
2-3 times/mo	18.1	17.7	23.5	14.9	
1-2 times/wk	28.5	28.2	28.5	25.9	
3-4 times/wk	20.2	21.1	22.2	26.1	
5-6 times/wk	10.4	11.3	7.6	9.6	
Once a day	9.0	7.9	4.0	6.2	
≥2 times/d	2.1	1.5	0.7	3.3	
Sugar-sweetened beverages					
≤ once/mo	39.6	36.1	25.5	26.1	**<0.001**
2-3 times/mo	12.2	17.7	12.3	15.6	
1-2 times/wk	16.8	12.4	20.5	16.5	
3-4 times/wk	10.0	11.7	12.3	14.5	
5-6 times/wk	6.1	6.0	11.9	7.4	
Once a day	7.9	9.0	9.6	8.4	
≥2 times/d	7.5	7.1	8.0	11.8	
Fried foods away from home					
≤ once/mo	39.8	35.7	30.1	36.5	**<0.001**
2-3 times/mo	25.6	27.1	27.8	22.5	

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Table 4. Differences in Prime Diet Quality Screener (PDQS-30D) component consumption frequency (%) by food security status among low-income adults in the United States between June 23 and July 1, 2020 (N = 1,739) (*continued*)

	Food Security Status				
Component	**High (n = 722)**	**Marginal (n = 266)**	**Low (n = 302)**	**Very Low (n = 449)**	***P* value[a]**
1-2 times/wk	24.8	25.2	22.5	21.2	
3-4 times/wk	7.3	7.9	13.3	11.6	
5-6 times/wk	1.5	3.0	4.3	3.8	
Once a day	0.8	1.1	1.3	1.8	
≥2 times/d	0.1	0	0.7	2.7	
Sweets and ice cream					
≤ once/mo	15.1	17.7	19.2	28.5	**<0.001**
2-3 times/mo	21.2	24.4	20.9	24.9	
1-2 times/wk	25.2	22.2	27.2	22.3	
3-4 times/wk	18.8	20.7	18.2	12.7	
5-6 times/wk	9.4	6.8	5.0	5.8	
Once a day	7.2	6.8	6.0	2.9	
≥2 times/d	3.1	1.5	3.6	2.9	
NEUTRAL	%	%	%	%	
Eggs					
≤ once/mo	16.2	19.2	10.3	17.6	0.150
2-3 times/mo	17.5	16.9	20.2	18.5	
1-2 times/wk	28.1	24.4	31.8	25.8	
3-4 times/wk	19.5	18.8	22.9	20.5	
5-6 times/wk	9.1	10.2	6.6	9.4	
Once a day	9.0	9.4	7.3	6.5	
≥2 times/d	0.6	1.3	2.0	1.8	

Bold values are statistically significant ($P < .05$).
[a]*P* values from Pearson's χ^2 test.

Table 5. Differences in Prime Diet Quality Screener (PDQS-30D) component consumption frequency by frequency of cooking dinner among low-income adults in the United States between June 23 and July 1, 2020 (N = 1,739)

	Dinner cooking frequency (times/wk)				
Component	7 (n = 637)	5-6 (n = 510)	3-4 (n = 340)	0-2 (n = 252)	*P* value[a]
Healthy					
Dark green leafy vegetables					
≤ once/mo	29.0	22.4	31.5	41.7	< **0.001**
2-3 times/mo	16.8	23.7	24.4	23.0	
1-2 times/wk	23.4	27.7	25.0	17.9	
3-4 times/wk	17.1	15.1	14.1	9.1	
5-6 times/wk	6.6	5.1	2.1	3.2	
Once a day	4.9	5.3	1.5	3.6	
≥2 times/d	2.2	0.8	1.5	1.6	
Cruciferous vegetables					
≤ once/mo	27.5	24.7	30.6	40.9	< **0.001**
2-3 times/mo	21.4	23.3	24.7	23.0	
1-2 times/wk	23.9	27.1	27.9	19.4	
3-4 times/wk	14.4	18.4	10.9	9.5	
5-6 times/wk	6.8	3.3	3.8	2.4	
Once a day	5.0	2.6	1.8	3.6	
≥2 times/d	1.1	0.6	0.3	1.2	
Deep orange vegetables					
≤ once/mo	36.4	29.4	41.5	48.4	< **0.001**
2-3 times/mo	23.7	32.0	24.4	21.8	
1-2 times/wk	25.1	22.9	21.2	16.3	
3-4 times/wk	8.8	9.4	7.4	7.9	
5-6 times/wk	2.8	4.3	4.4	2.4	
Once a day	2.2	1.4	0.6	2.8	
≥2 times/d	0.9	0.6	0.6	0.4	
Other vegetables					
≤ once/mo	18.7	13.9	24.1	31.4	< **0.001**
2-3 times/mo	20.7	18.6	23.2	22.6	
1-2 times/wk	24.8	31.0	27.9	23.4	
3-4 times/wk	19.0	26.1	16.5	13.9	
5-6 times/wk	10.4	6.9	5.6	4.4	
Once a day	5.0	2.4	1.2	3.2	
≥2 times/d	1.4	1.2	1.5	1.2	
Citrus fruits					
≤ once/mo	34.9	25.3	32.4	40.1	< **0.001**
2-3 times/mo	21.5	23.9	28.5	22.2	
1-2 times/wk	18.4	22.6	19.4	18.7	
3-4 times/wk	11.5	13.5	13.8	10.7	
5-6 times/wk	5.2	7.8	2.7	3.2	

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Table 5. Differences in Prime Diet Quality Screener (PDQS-30D) component consumption frequency by frequency of cooking dinner among low-income adults in the United States between June 23 and July 1, 2020 (N = 1,739) (*continued*)

	Dinner cooking frequency (times/wk)				
Component	7 (n = 637)	5-6 (n = 510)	3-4 (n = 340)	0-2 (n = 252)	*P* value[a]
Once a day	6.1	5.7	1.8	4.0	
≥2 times/d	2.5	1.2	1.5	1.2	
Deep orange fruits					
≤ once/mo	60.2	50.8	54.7	56.0	**0.012**
2-3 times/mo	16.5	21.6	22.1	21.0	
1-2 times/wk	12.6	16.7	12.4	13.9	
3-4 times/wk	6.0	4.5	7.4	7.9	
5-6 times/wk	1.7	3.5	2.1	0.4	
Once a day	2.5	2.2	0.9	0.4	
≥2 times/d	0.6	0.8	0.6	0.4	
Other fruits					
≤ once/mo	20.7	11.4	20.3	26.2	< **0.001**
2-3 times/mo	24.3	23.5	29.7	27.0	
1-2 times/wk	22.0	24.7	25.3	25.4	
3-4 times/wk	15.2	22.0	16.5	11.1	
5-6 times/wk	7.4	9.6	5.6	5.6	
Once a day	7.5	6.7	2.7	3.6	
≥2 times/d	2.8	2.2	0.0	0.8	
Legumes					
≤ once/mo	23.4	20.6	32.1	34.1	< **0.001**
2-3 times/mo	23.7	28.0	28.2	28.6	
1-2 times/wk	26.7	32.0	22.4	23.4	
3-4 times/wk	15.4	13.5	11.8	7.5	
5-6 times/wk	5.7	3.9	3.8	5.2	
Once a day	3.1	1.8	1.2	1.2	
≥2 times/d	2.0	0.2	0.6	0.0	
Nuts and seeds					
≤ once/mo	34.2	29.6	34.1	39.3	< **0.001**
2-3 times/mo	19.3	24.3	25.3	26.6	
1-2 times/wk	19.5	24.5	20.0	15.1	
3-4 times/wk	11.5	11.6	16.5	10.7	
5-6 times/wk	7.5	5.3	2.9	4.4	
Once a day	5.8	3.9	0.9	2.4	
≥2 times/d	2.2	0.8	0.3	1.6	
Poultry					
≤ once/mo	13.3	7.5	10.9	16.3	**0.001**
2-3 times/mo	17.4	16.5	22.1	25.8	
1-2 times/wk	31.4	35.5	35.3	27.0	
3-4 times/wk	24.2	27.8	21.8	19.8	

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Table 5. Differences in Prime Diet Quality Screener (PDQS-30D) component consumption frequency by frequency of cooking dinner among low-income adults in the United States between June 23 and July 1, 2020 (N = 1,739) (*continued*)

	Dinner cooking frequency (times/wk)				
Component	7 (n = 637)	5-6 (n = 510)	3-4 (n = 340)	0-2 (n = 252)	*P* value[a]
5-6 times/wk	8.8	8.6	7.4.	5.6	
Once a day	3.5	2.8	2.1	4.0	
≥2 times/d	1.4	1.4	0.6	1.6	
Fish					
≤ once/mo	42.7	40.6	45.9	48.8	0.217
2-3 times/mo	24.8	27.7	27.1	27.8	
1-2 times/wk	24.3	23.3	17.4	14.7	
3-4 times/wk	5.3	5.9	6.2	6.4	
5-6 times/wk	2.0	2.2	2.4	1.6	
Once a day	0.5	0.2	0.3	0.8	
≥2 times/d	0.3	0.2	0.9	0.0	
Whole grains					
≤ once/mo	17.4	15.5	14.4	22.2	< **0.001**
2-3 times/mo	15.4	14.1	21.2	17.9	
1-2 times/wk	21.5	26.9	26.8	28.2	
3-4 times/wk	19.0	22.4	20.3	14.3	
5-6 times/wk	12.6	11.4	10.9	8.7	
Once a day	10.4	8.8	5.0	7.5	
≥2 times/d	3.8	1.0	1.5	1.2	
Low-fat dairy					
≤ once/mo	32.8	27.1	29.7	36.1	< **0.001**
2-3 times/mo	11.99	13.1	19.4	17.9	
1-2 times/wk	16.5	21.6	22.4	14.3	
3-4 times/wk	13.8	17.7	14.1	13.5	
5-6 times/wk	7.9	7.8	6.5	10.7	
Once a day	12.1	11.4	4.4	6.4	
≥2 times/d	5.0	1.4	3.5	1.2	
Liquid vegetable oils					
≤ once/mo	28.4	19.4	27.9	47.6	< **0.001**
2-3 times/mo	18.8	17.5	22.7	20.2	
1-2 times/wk	20.1	28.2	24.7	14.7	
3-4 times/wk	13.5	18.0	15.3	9.5	
5-6 times/wk	9.4	10.4	6.2	5.2	
Once a day	6.8	5.1	2.4	2.4	
≥2 times/d	3.0	1.4	0.9	0.4	
UNHEALTHY					
Red meat as a main dish					
≤ once/mo	21.5	13.3	17.7	26.2	< **0.001**
2-3 times/mo	19.5	18.6	24.4	31.0	

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Table 5. Differences in Prime Diet Quality Screener (PDQS-30D) component consumption frequency by frequency of cooking dinner among low-income adults in the United States between June 23 and July 1, 2020 (N = 1,739) (*continued*)

	Dinner cooking frequency (times/wk)				
Component	7 (n = 637)	5-6 (n = 510)	3-4 (n = 340)	0-2 (n = 252)	*P* value[a]
1-2 times/wk	32.5	35.1	35.9	25.8	
3-4 times/wk	18.8	25.3	15.6	13.5	
5-6 times/wk	6.1	5.3	4.7	2.0	
Once a day	1.1	2.0	0.9	1.2	
≥2 times/d	0.5	0.4	0.9	0.4	
Processed meat					
≤ once/mo	26.2	17.8	18.8	25.8	**0.009**
2-3 times/mo	22.9	22.4	29.4	25.8	
1-2 times/wk	27.0	32.9	26.2	30.2	
3-4 times/wk	14.8	18.8	18.8	12.3	
5-6 times/wk	5.3	5.3	5.0	4.0	
Once a day	3.0	2.2	1.8	1.2	
≥2 times/d	0.8	0.6	0.0	0.8	
Potatoes					
≤ once/mo	22.9	16.1	24.1	33.7	< **0.001**
2-3 times/mo	18.2	15.7	14.4	21.4	
1-2 times/wk	25.0	30.4	30.3	18.3	
3-4 times/wk	21.7	26.5	22.7	15.5	
5-6 times/wk	7.4	8.0	6.5	7.1	
Once a day	3.1	2.9	1.2	3.2	
≥2 times/d	1.7	0.4	0.9	0.8	
Refined grains and baked goods					
≤ once/mo	14.3	7.8	12.7	18.7	< **0.001**
2-3 times/mo	16.2	16.7	20.3	23.4	
1-2 times/wk	27.9	29.4	28.8	22.6	
3-4 times/wk	18.4	28.8	21.7	19.1	
5-6 times/wk	11.0	9.8	9.1	7.9	
Once a day	9.6	5.7	5.6	6.8	
≥2 times/d	2.7	1.8	1.8	1.6	
Sugar-sweetened beverages					
≤ once/mo	42.2	27.3	26.2	31.4	< **0.001**
2-3 times/mo	12.1	13.7	15.6	16.7	
1-2 times/wk	14.0	18.2	20.3	15.5	
3-4 times/wk	8.2	15.1	15.0	9.9	
5-6 times/wk	6.8	8.4	7.7	6.8	
Once a day	7.8	9.2	7.9	9.5	
≥2 times/d	9.1	8.0	7.1	10.3	
Fried foods away from home					
≤ once/mo	52.6	27.1	22.1	35.3	<**0.001**
2-3 times/mo	22.5	29.4	24.7	25.8	

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Table 5. Differences in Prime Diet Quality Screener (PDQS-30D) component consumption frequency by frequency of cooking dinner among low-income adults in the United States between June 23 and July 1, 2020 (N = 1,739) (*continued*)

	Dinner cooking frequency (times/wk)				
Component	**7 (n = 637)**	**5-6 (n = 510)**	**3-4 (n = 340)**	**0-2 (n = 252)**	***P* value[a]**
1-2 times/wk	15.9	30.2	28.8	22.2	
3-4 times/wk	5.2	9.8	16.8	10.3	
5-6 times/wk	2.2	1.8	5.6	2.8	
Once a day	1.1	0.8	1.2	2.4	
≥2 times/d	0.6	1.0	0.9	1.2	
Sweets and ice cream					
≤ once/mo	25.6	12.0	15.6	25.8	**< 0.001**
2-3 times/mo	22.9	19.6	22.9	27.4	
1-2 times/wk	21.0	28.6	26.8	20.6	
3-4 times/wk	13.8	22.9	20.3	11.5	
5-6 times/wk	7.9	7.1	7.7	6.0	
Once a day	5.6	7.5	4.4	5.2	
≥2 times/d	3.3	2.4	2.4	3.6	
Neutral					
Eggs					
≤ once/month	17.0	10.4	16.2	24.6	**< 0.001**
2-3 times/month	14.4	17.7	22.4	22.6	
1-2 times/week	25.1	28.4	30.6	28.2	
3-4 times/week	19.6	25.1	17.9	15.1	
5-6 times/week	10.8	9.4	7.9	4.4	
Once a day	11.5	8.4	3.8	4.8	
≥2 times/d	1.6	0.6	1.2	0.4	

Bold values are statistically significant ($P < .05$).
[a]*P* values from Pearson χ^2 tests.

Table 6. Sampling quotas, distribution of the final sample, and census demographic estimates[a]

Characteristic	Quota name	Field Target	Final Sample	2019 ACS[b]
		←——— % ———→		
Age[c]	18 to 24 years old	13	—	12
	25 to 44 years old	41	—	34
	45 to 64 years old	30	—	33
	Over 65 years old	16	—	21
	18-29 years old	—	25	21
	30-39 years old	—	20	17
	40-49 years old	—	14	16
	50-59 years old	—	14	16
	60-69 years old	—	18	15
	70-79 years old	—	7	9
	80+ years old	—	1	5
Sex[d]	Male	50	48	49
	Female	50	51	51
Ethnicity	Hispanic	11	14	18
	Not Hispanic	89	86	82
Race	Black	12	12	13
	White	70	72	72
	Other race	18	16	17
Region	Midwest	22	22	21
	Northeast	18	19	17
	South	37	37	38
	West	23	22	23
Household size	Household Size 1 and maximum annual household income $31,900	25	23	26
	Household Size 2 and maximum annual household income $43,100	32	30	33
	Household Size 3 and maximum annual household income $54,300	18	20	17
	Household Size 4 and maximum annual household income $65,500	16	16	14
	Household Size 5 and maximum annual household income $76,700	6	7	7
	Household Size 6 and maximum annual household income $87,900	2	4	3
	Household Size 7 and maximum annual household income $110,000	1		2

[a]This study used a census-matched panel of US adults aged 18 years or older (matched on age, sex, and race and ethnicity to the overall US population. The sample was limited to adults with annual household income <250% of the 2020 federal poverty level. This table shows the quotas used to recruit participants with CloudResearch (Quota), the actual sample recruited (Field Sample), in comparison to demographics of the US population based on the American Community Survey.

[b]ACS = American Community Survey 2019 1-year estimates.

[c]Age categories the study collected did not align completely with the target sampling age categories.

[d]Gender identity was not included as a criteria for sampling (the census-matched panel was based on sex not gender) and is therefore not included as a point of comparison here.