

Examining the Link between Food Acquisition Methods  
and Dietary Quality among Asian Americans

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Extended Abstract

Background

"Food acquisition method" refers to the ways in which individuals and households obtain food, including purchasing food at supermarkets and other food outlets, eating out, carry-out, growing their own food, participating in food assistance programs, and receiving food from other sources such as friends, family, or community organizations (Mancino et al., 2018).

Different food acquisition methods can have differential impacts on dietary quality. Studies have found that supermarkets generally have a wider selection of healthy food options, such as fresh fruits and vegetables, compared to other food outlets, such as convenience stores. Research has also shown that eating out and carry-out is generally associated with lower dietary quality and higher intake of energy-dense foods high in saturated fat, sugar, and sodium. As such, there is a general consensus in the literature that consumers who cook meals at home using food purchased from supermarkets have higher dietary quality than consumers who buy food from other food outlets, eat out, or order carry-out foods (Casagrande et al., 2011; Neckerman et al., 2009).

One way to measure food acquisition methods is to assess the consumer's neighborhood food environment (Bader et al., 2010; Fan et al., 2014). The relationship between food environment, dietary quality, and health outcomes has been a widely studied topic in recent years. Many studies have shown that the food environment plays an essential role in shaping dietary habits and ultimately impacting health outcomes. The availability and accessibility of healthy food options, typically measured by proximity to supermarkets, can affect individual dietary choices and lead to improved dietary quality. Conversely, a lack of access to supermarkets but close proximity to convenience stores can lead to the consumption of a diet high in processed foods and added sugars, contributing to the development of diet-related health problems such as obesity, type 2 diabetes, and cardiovascular disease (Caspi et al., 2012; Minaker et al., 2013; Morland & Evenson, 2009).

The food environment has limitations as a proxy for food consumption due to several factors: First, accessibility does not equal consumption: The proximity of a food outlet does not

guarantee that individuals will purchase and consume the available food in that particular outlet. Second, food availability does not equal food consumption quality: The presence of a supermarket offering healthy food options does not mean that all consumers shopping there purchase these healthy options. Third, food purchases are not limited to nearby outlets: Individuals may choose to purchase food from further away outlets or engage in food preparation at home. Fourth, socio-demographic factors can interact with the neighborhood food environment to impact food choices: Personal, social, and economic factors such as income, education, and culture play a significant role in determining food choices, even if consumers live in the same neighborhood. These limitations highlight the importance of supplementing food environment data with other measures, such as food consumption patterns, to fully understand individual food behavior.

Race and ethnicity are important factors that can modify the relationship between food acquisition methods and dietary quality. Research has shown significant disparities in dietary habits, health outcomes, and access to healthy food among racial and ethnic groups. These disparities are influenced by a complex interplay of factors, including socioeconomic status, cultural norms and practices, historical discrimination, and access to resources (Althoff et al., 2022; Leung & Tester, 2019). As such, studying healthy eating habits and food acquisition methods by race and ethnicity is essential. By understanding the specific challenges and barriers faced by different racial and ethnic groups regarding healthy eating and food acquisition, researchers and policymakers can develop targeted interventions and policies that aim to reduce dietary quality disparities and improve overall health outcomes.

Similarly, individuals who rely primarily on food assistance programs or other food assistance may have different dietary quality than those who can purchase food without assistance. Understanding the different food acquisition methods and their impact on dietary quality can help inform public health and nutrition policies and interventions to improve dietary quality and reduce diet-related health disparities.

This study focuses on the link between food acquisition methods, food stamp recipient status, and dietary quality among Asian Americans using the 2015-2018 National Health (NHANES). Research on Asian Americans' dietary quality and dietary patterns has shown that they generally have higher overall dietary quality than other racial and ethnic groups, particularly in the categories of total fruit, whole fruit, total vegetables, greens and beans, and dairy. This is likely partly due to traditional Asian diets, which often include high levels of fruits and vegetables and a focus on plant-based foods. On the other hand, Asian Americans consume high levels of sodium and low levels of dairy products (Tao et al., 2022). We use data on self-reported expenditure data on four types of food outlets: (1) supermarkets, (2) other outlets, (3) eating out, and (4) carry-out together and study the impact of food budget share on these four outlets on dietary quality, measured by the Healthy Eating Index (HEI-2015), among Asian Americans.

## Conceptual Discussion

Conceptually, consumer food choices are based on preferences and constraints. Consumers may have different preferences for food taste and variety. These preferences are often related to culture and upbringing, which are related to SES. Constraints can include budget, time, and health constraints, affecting how consumers prioritize different issues when making food choices. These various issues can be broadly categorized into cost, convenience, and nutrition. Consumers with less money are likely to prioritize cost over nutrition and convenience, where as consumers with less time are likely to prioritize convenience over either cost or nutrition. Consumers with a health condition may be on special diets that limit their food choices.

Food acquisition methods are likely associated with food choices and dietary quality. Supermarkets are generally considered to have a wide variety of food choices with relatively low costs for healthy (and unhealthy) food options. In contrast, other stores that sell food, such as convenience stores, may offer convenience but not nutritious foods. Consumers are likely to eat out in restaurants for social, taste, and food variety reasons, but not for cost and nutrition. Finally, consumers purchasing fast food and carry-out foods are likely concerned about convenience instead of nutrition. All in all, supermarket purchase is most likely linked to better dietary quality, while other forms of food acquisition are not likely focused on nutrition and may or may not be linked to dietary quality.

## Method

### Data

Data from two cycles (2015-2016 and 2017-2018) of the National Health and Nutrition Examination Survey (NHANES) were evaluated to examine dietary patterns among Asian American adults. NHANES is a series of cross-sectional surveys using a complex, multistage probability design to sample the civilian, noninstitutionalized population residing in the 50 states and the District of Columbia. The US Department of Agriculture (USDA) Automated Multiple-Pass Method was used for collecting 24-hour dietary recalls using "What We Eat In America," the dietary interview component of NHANES. The NHANES protocol was approved by the Centers for Disease Control and Prevention/National Center for Health Statistics Ethics Review Board. Because NHANES data are publicly available and deidentified, institutional review board approval was not required for this analysis.

A total of 1,575 Asian Americans 18 and older participated in the NHANES from 2015 to 2018. Out of these, 1,099 completed at least one valid 24-hour diet recall and were included in this analysis.

### Measurement

Dietary quality was measured by the 2015 Healthy Eating Index (HEI-2015), a scoring metric that reflects both overall dietary quality and a range of nutritional components (Krebs-Smith et al., 2018). The National Cancer Institute (NCI) and USDA collaboratively developed the HEI-2015 to assess compliance with the 2015-2020 Dietary Guidelines of Americans.

Specifically, HEI-2015 includes 13 dietary components that belong to two groups: the adequacy group and the moderation group. Nine of the 13 components are in the adequacy group, where higher scores reflect higher intakes: total fruits (including 100% fruit juice), whole fruits (including all forms except juice), total vegetables, greens and beans, whole grains, dairy (including all milk products, such as fluid milk, yogurt, cheese, and fortified soy beverages), total protein foods, seafood and plant proteins (including seafood, nuts, seeds, soy products other than beverages, and legumes), and fatty acids (ratio of poly- and mono-unsaturated fatty acids to saturated fatty acids). The remaining four components are in the moderation group, where higher scores reflect lower intakes: refined grains, sodium, added sugars, and saturated fats. For each component, the minimum score is 0 points, and the maximum score is either 5 or 10 points. All 13 component scores are then added to get a total score reflecting the overall diet quality, with a possible range of 0-100 points. A higher value in the total score and each component score reflects closer alignment with the Dietary Guidelines for Americans and better dietary quality. The simple scoring algorithm method was used based on 24-hour dietary recall data from NHANES and the Food Patterns Equivalent Database (FPED) to create HEI-2015 scores. Two days of dietary recall data were used for those with two days of recall data, and one day of dietary recall data was used for those with only one day of recall data.

While the composite HEI-2015 scores are useful in assessing overall dietary quality, scores for the components of HEI-2015 contain rich, multidimensional information that can aid our understanding of variations in dietary patterns that may be very different, even if these patterns generate the same total HEI-2015 score. As such, the component scores of HEI-2015, in addition to the composite HEI-2015 scores, were analyzed.

We used self-reported household expenditure data on four types of food outlets: (1) supermarkets, (2) other outlets, (3) eating out, and (4) carry-out together. All food expenditures were added to form the total monthly food expenditure, then divided by household size to form per capita monthly food expenditure. Food budget shares were computed for money spent in each of the four food acquisition methods.

We controlled for two categories of variables: demographic and SES variables and other food-related variables. For demographic and SES variables, we included age (18-34, 35-49, 50-64, and 65+), sex (male vs. female), marital status (married or cohabitating vs. not), education level (less than high school, high school graduates, some college, and college graduates), employment status (full-time, part-time, and not working/retired), and foreign-born status. For food-related variables, we included total monthly food expenditure, household food security status, food stamp recipient status, special diet status, and average daily caloric intake.

## Statistical Methods

Descriptive statistics corrected for survey design were computed. To tease out the effects of food acquisition methods from other confounders, regression models were estimated controlling for the following socioeconomic and demographic variables: age (18-34 as the reference group, 35-

49, 50-64, and 65+), sex (male vs. female as the reference group), marital status (married or cohabitating vs. not as the reference group), education levels (less than high school, high school graduates as the reference group, some college, and college graduates), employment status (full-time, part-time, and not working/retired as the reference group), and foreign-born (native-born as the reference group). In addition, we analyzed additional food-related variables, including household food security, food stamp recipient status, special diet status, and average daily caloric intake. Regressions were conducted on the total HEI-2015 score as well as the 13 component scores. SAS 9.4 Proc Surveymeans and Proc Surveyreg were used for these analyses.

## Results

Tables 1-5 and Figure 1 present the results of our statistical analysis.

### Summary of findings

Food acquisition methods are linked to dietary quality, but for the total HEI-2015 score, only food budget share for carry-out is significant - and bad for dietary quality. However, component scores give a more detailed picture.

Higher food budget share spent at supermarkets is associated with better scores in multiple components, including veggies, greens and beans, protein, seafood and other plant protein, and saturated fat. However, a higher food budget share spent at supermarkets is associated with a worse score in sodium intake. A higher budget share spent on eating out is associated with better scores on refined grains but worse scores on greens and beans and saturated fat. Our findings show that nothing good comes out of a higher budget share on carry-out food. A higher budget share on carry-out food is associated with lower scores on seven of the thirteen HEI-2015 components, including total fruits, whole fruits, total vegetables, greens and beans, whole grain, seafood and plant protein, and added sugar. However, it is not associated with sodium intake.

Except for carry-out, effect sizes are generally small. We tested for moderation effects with demographic and other SES variables. No significant moderation effects were found.

### Implications

For individual consumers who want to improve their dietary quality, the message is to cut down on carry-out foods. Also, it is important to know that shopping at supermarkets and cooking at home is not automatically translated into better dietary quality. In fact, Asian Americans should watch for sodium intake at home in order to attain better dietary quality.

From a public health perspective, it is essential to send out the message about the negative health consequences of sodium intake among Asian Americans. It may also be beneficial to craft a message to pay attention to the nutritional values of carry-out foods through education, disclaimers, or food labeling.

Table 1. Weighted HEI-2015 scores and component scores of non-Hispanic Asian American adults: NHANES 2015-2018

Variable	Mean Score	Std Error of Score	Score as a Percentage of Perfect Score
Total HEI-2015 Score	58.95	0.74	58.9%
Component HEI-2015 Scores:			
Total Fruits (Max. 5)	2.94	0.07	58.8%
Whole Fruits (Max. 5)	3.22	0.08	64.5%
Total Vegetables (Max. 5)	3.65	0.07	73.0%
Greens & Beans (Max. 5)	2.83	0.12	56.6%
Whole Grains (Max. 10)	3.70	0.13	37.0%
Total Dairy (Max. 10)	4.17	0.20	41.7%
Total Protein Foods(Max. 5)	4.45	0.05	89.1%
Seafood & Plant Proteins (Max. 5)	3.45	0.12	69.0%
Fatty Acids (Max. 10)	6.15	0.14	61.5%
Refined Grains (Max. 10)	5.24	0.14	52.4%
Sodium (Max. 10)	3.11	0.17	31.1%
Added Sugars (Max. 10)	8.67	0.10	86.7%
Saturated Fats (Max. 10)	7.34	0.14	73.4%
Sample Size	1,099		

Figure 1. Component HEI-2015 scores as a percentage of perfect scores for non-Hispanic Asian American adults: NHANES 2015-2018

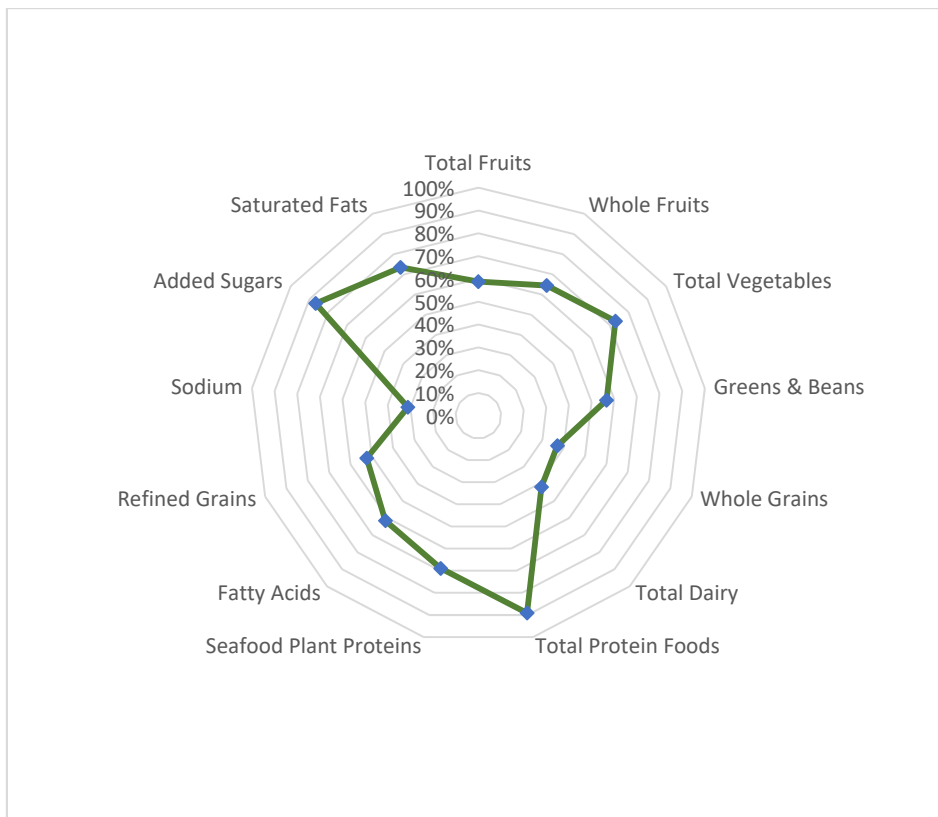


Table 2. Weighted descriptive statistics of non-Hispanic Asian American adults: NHANES 2015-2018

Variable	Mean	Std. Error
Age 18-34 (%)	37.54	1.89
Age 35-49 (%)	25.34	1.70
Age 50-64 (%)	23.90	1.29
Age 65+ (%)	13.22	1.58
Male (%)	46.82	1.44
Less than high school education (%)	11.79	2.02
High school graduate (%)	15.84	1.97
Some college education (%)	18.52	1.56
College education or more (%)	53.84	3.51
Married or cohabitating (%)	69.37	1.65
Foreign-born (%)	84.86	1.98
Full-time employment (%)	46.54	2.02
Part-time employment (%)	19.35	1.87
Monthly per capita food expenditure (in 100 dollars)	3.29	0.23
Share of food expenditure spent at supermarkets (%)	53.06	1.28
Share of food expenditure spent at other food outlets (%)	20.83	1.32
Share of food expenditure spent eating out (%)	22.22	1.10
Share of food expenditure spent on carry-out (%)	3.89	0.39
Household food insecure (%)	9.48	2.23
Household receiving food stamps (%)	12.07	2.97
On special diet (%)	14.44	1.20
Average daily caloric intake (in 100 kcal)	18.77	0.22
Sample size	1,099	

Table 3. PROC Surveyreg regression results on total HEI-2015 score for non-Hispanic Asian American adults: NHANES 2015-2018

Variable	Total HEI-2015 Score	
	Coefficient	
Intercept	50.108	***
Age 35-49	-0.484	
Age 50-64	4.431	***
Age 65+	6.719	***
Male	-1.708	**
Less than high school education	-1.767	
Some college education	1.133	
College education or more	4.947	***
Married or cohabitating	3.434	***
Foreign-born	2.684	**
Full-time employment	-2.926	**
Part-time employment	-3.061	**
Monthly per capita food expenditure (in 100 dollars)	0.188	
Share of food expenditure spent at super markets (%)	-0.006	
Share of food expenditure spent eating out (%)	0.010	
Share of food expenditure spent on carry-out (%)	-0.162	**
Household food insecure	-2.361	
Household receiving food stamps	-1.284	
On special diet	2.008	
Average daily caloric intake (in 100 kcal)	0.119	
R-Squared	0.153	

Note: \*\*\* denotes  $p < 0.01$ . \*\* denotes  $p < 0.05$ . \* denotes  $p < 0.1$ .



Table 4. PROC Surveyreg regression results on HEI-2015 scores for adequate component categories for non-Hispanic Asian American adults: NHANES 2015-2018

Variable	Total Fruit Coefficient	Whole Fruit Coefficient	Total Vegetables Coefficient	Greens & Beans Coefficient	Whole Grain Coefficient	Dairy Coefficient	Total Protein Coefficient	Seafood & Plant Proteins Coefficient	Fatty Acids Coefficient
Intercept	2.442 ***	2.296 ***	3.498 ***	2.426 ***	3.320 ***	4.436 ***	4.117 ***	1.773 ***	4.870 ***
Age 35-49	0.199	0.327	-0.082	0.191	-0.368	-0.388	0.105	0.225	-0.184
Age 50-64	0.874 ***	0.940 ***	0.159	0.301 *	0.380	-0.985 ***	0.114	0.799 ***	0.633 **
Age 65+	0.875 ***	1.165 ***	0.131	0.479 ***	0.414	-0.712 *	0.431 ***	1.005 ***	0.913 **
Male	-0.287 **	-0.308 *	-0.094	-0.202	0.445 **	-0.578 ***	0.006	-0.360 **	-0.115
Less than high school education	-0.437	-0.479	-0.054	0.047	-0.044	0.569	-0.128	-0.172	-0.120
Some college education	-0.011	0.075	0.105	0.288	-0.035	0.227	0.091	0.400	0.093
College education or more	0.148	0.357	0.203	0.803 ***	1.256 ***	0.985 ***	-0.051	0.936 ***	-0.205
Married or cohabitating	0.164	0.361 **	0.438 ***	0.384 ***	0.848 ***	-0.085	-0.005	0.217	0.375
Foreign-born	0.190	0.297	0.353 **	0.032	0.391	-0.242	-0.218 *	-0.019	0.336
Full-time employment	-0.292	-0.451 *	-0.049	-0.194	-1.089 ***	-0.177	0.063	-0.049	0.247
Part-time employment	-0.242	-0.383	-0.189	-0.374	-0.664 **	0.016	0.021	0.016	-0.365
Monthly per capita food expenditure (in 100 dollars)	0.006	0.005	0.031 *	0.042	-0.100	-0.191 ***	0.045 ***	0.057 **	0.188 ***
Share of food expenditure spent at supermarkets (%)	-0.044	-0.005	0.006 *	0.006 *	-0.111	-0.003	0.005 *	0.006 *	0.005
Share of food expenditure spent eating out (%)	0.000	-0.003	-0.003	-0.010 *	-0.001	0.001	-0.002	-0.004	0.003
Share of food expenditure spent on carry-out (%)	-0.013 *	-0.018 *	-0.011 *	-0.036 ***	-0.050 ***	0.013	0.001	-0.030 **	-0.012
Household food insecure	0.073	-0.113	-0.812 ***	-0.654 **	0.161	0.218	0.065	-0.464 *	-0.746
Household receiving food stamps	0.010	0.296	-0.156	-0.451 **	0.333	-0.188	-0.075	-0.356	-0.546
On special diet	-0.025	0.046	-0.199	-0.070	0.612	0.059	0.262 **	0.045	0.535 *
Average daily caloric intake (in 100 kcal)	0.004	0.013	-0.014	0.009	-0.034	0.034 **	0.019 **	0.054 ***	0.009
R-Squared	0.074	0.112	0.101	0.093	0.095	0.067	0.047	0.145	0.062

Note: \*\*\* denotes  $p < 0.01$ . \*\* denotes  $p < 0.05$ . \* denotes  $p < 0.1$ .

Table 5. PROC Surveyreg regression results on HEI-2015 scores for moderation component categories for non-Hispanic Asian American adults: NHANES 2015-2018

Variable	Refined Grain Coefficient	Sodium Coefficient	Added Sugar Coefficient	Saturated Fat Coefficient
Intercept	4.092 ***	1.545 **	7.716 ***	7.577 ***
Age 35-49	0.215	-0.117	-0.332 *	-0.276
Age 50-64	0.827 *	0.247	0.133	0.010
Age 65+	0.898 **	0.617 **	0.119	0.381
Male	-0.631 ***	-0.529 **	0.525 ***	0.419
Less than high school education	-0.620	-0.538	0.486 *	-0.277
Some college education	0.586	-0.064	0.206	-0.828 *
College education or more	0.368	0.298	0.466	-0.617 **
Married or cohabitating	-0.216	0.026	0.633 ***	0.292
Foreign-born	-0.469	-0.231	0.822 ***	1.441 ***
Full-time employment	-0.487 *	-0.210	-0.174	-0.064
Part-time employment	-0.237	0.012	-0.202	-0.470
Monthly per capita food expenditure (in 100 dollars)	0.081 **	-0.074	0.000	0.100 ***
Share of food expenditure spent at supermarkets (%)	-0.004	-0.025 ***	0.001	0.016 ***
Share of food expenditure spent eating out (%)	0.037 ***	0.010	-0.003	-0.015 *
Share of food expenditure spent on carry-out (%)	0.018	0.015	-0.041 ***	0.001
Household food insecure	-0.358	0.342	0.022	-0.096
Household receiving food stamps	-0.796	0.631	-0.036	0.049
On special diet	0.603	0.119	-0.109	0.130
Average daily caloric intake (in 100 kcal)	0.025 *	0.065 ***	-0.019 **	-0.046 ***
R-Squared	0.096	0.060	0.115	0.096

Note: \*\*\* denotes  $p < 0.01$ . \*\* denotes  $p < 0.05$ . \* denotes  $p < 0.1$ .

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