

A Discrete Choice Analysis of Household Dietary Choice

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Abstract

With obesity rates continually rising in the U.S. from 1999 to 2018 (CDC, 2020), policymakers have taken a keen interest in increasing healthy food access to American households. However, what is not so sure is how policymakers can best alter a household's dietary habits for the better. This paper helps bridge this gap in information by using the National Household Food Acquisition and Purchase Survey (FoodAPS) to analyze which household characteristics and environmental factors influence a household's choice to eat healthy or unhealthy using a multinomial logit model. In particular, we allow for household income, household size, demographic characteristics, access to food assistance programs, and local retail food environments to play a vital role in explaining household food choice patterns. We find that education, income, household size, age, marriage status, access to food assistance programs, and distance from households to fast food restaurants have a statistically significant effect on household dietary choice.

Keywords: Dietary choice, multinomial logit model, food assistance programs

1 Introduction

With obesity rates continually rising in the U.S. from 1999 to 2018 (CDC, 2020), obesity has become a full-blown epidemic in the United States (Nia et al., 2011). Through 2017-2018, the prevalence of obesity among adults was roughly 42.4%, and severe obesity had grown from 4.7% in 1999-2000 to 9.2% in 2017-2018. This high rate of obesity poses a significant threat to the overall health of the country as some of the conditions associated with obesity are heart disease, stroke, type 2 diabetes, and certain types of cancer, all of which are some of the leading causes of premature death (CDC, 2020). Not only has obesity been harmful to the health of Americans, but it has been an expensive epidemic as well. In a study done by Finkelstein et al., they estimate that the annual medical cost of obesity in the United States was \$147 billion in 2008 U.S. dollars (Finkelstein et al., 2008).

Given the solemnity of this epidemic, decreasing the prevalence of obesity in the United States has garnered much attention amongst policymakers and public figures. And a popular avenue through which policymakers have attempted to lower obesity rates has been by increasing healthier food options to areas known as food deserts¹ as poor diet is shown to be an important driver of differences in obesity rates (Cutler et al., 2003, Park et al. 2015). For example, the 2014 Farm Bill allocated \$125 million to the USDA for the explicit purpose of eliminating food deserts. Rep. Schwartz (PA-13) summarizes the goal of this legislation: “[b]y establishing healthier food options in underserved areas, millions of Americans will have the opportunity to live longer, healthier lives, saving billions in health care costs.” (Taylor and Villas-Bolas, 2016). A more recent example is a New Jersey bill signed in 2019, establishing a program to provide residents of food desert communities with access to fresh and affordable produce for two years (ASTHO, 2019).

However, as Taylor and Villas-Bolas point out, increasing an area's access to healthier foods may not be the most efficient way of incentivizing households to eat healthier. Other factors such as income, food preferences, or access to transportation could be determining why households are choosing to eat healthily or not. In fact, a study done by Cummins et al. evaluates the impact of opening a new supermarket in a food desert in Philadelphia and finds that the new store improved residents' perception of food accessibility but did not lead to changes to dietary

¹ Food deserts, as defined by Medical News Today, are regions where people have limited access to affordable and healthful food.

habits over the four years of the study (Cummins et al., 2014). Further corroborating this skepticism, Vaughan et al. point out that differences at the individual level explain more unique variance in unhealthy diets than environmental differences (Vaughan et al., 2017).

This raises an important question, which is the primary focus of this paper, which household and environmental factors have the most significant influence on the dietary habits of households? We use the National Household Food Acquisition and Purchase Survey (FoodAPS) dataset and a multinomial logit model to answer this question. The FoodAPS dataset is a nationally representative sample of 4826 households within the U.S. that includes detailed information about purchases and acquisitions of food items intended for consumption at home and away from home, as well as foods acquired through USDA and other food and nutrition assistance programs. In particular, we allow for household income, household size, demographic characteristics, access to food assistance programs, and local retail food environments to play a vital role in explaining household food choice patterns. We find that education, income, household size, age, marriage status, access to food assistance programs, and distance from households to fast food restaurants have a statistically significant effect on household dietary choice.

The rest of this paper is organized as follows: the second section provides a literature review about household dietary choice, the third section covers data and methodology, the fourth section talks about our empirical strategy, the fifth section presents our empirical results, the sixth section discusses these results, and the final section concludes.

2 Literature Review

The literature on household food choice is broad, with many opinions about what influences household eating decisions. Not only this but there is skepticism within the literature if there is an effective way to incentivize people to change their diets. For example, in her analysis of how people's diets change after being diagnosed with diabetes, Oster finds that while there is a statistically significant reduction in caloric intake after diagnosis, the amount is relatively small (Oster, 2018). She attributes this reduction to behavioral changes within households. It's also worth noting that Oster also finds that increased information about the

health consequences of a poor diet has little to no influence on dietary choice. Additionally, Hut finds that while social interactions and community influence can affect a household's diet, nutritional habits are highly persistent (Hut, 2020). Nevertheless, most of the literature indicates that two primary factors determine dietary habits within households: households' individual and environmental characteristics (Bauer and Reisch, 2018).

Firstly, individual characteristics refer to characteristics inherent to the head of the household, such as education, income, race, food preferences, etc. It's these traits of a household that Vaughan et al. indicate are essential determinants of dietary choice. More specifically, using data collected by interviewing low-income and predominately African American neighborhoods in Pittsburgh, Vaughan et al. find that sociodemographic characteristics (such as age, gender, and education) greatly influence diet using a multivariate regression model (Vaughan et al., 2017). Similarly, Staus finds that household attitudes about quality, freshness, environment, advertisement, organic food, and prices play an important part in dietary choice within German meat markets using a mixed logit model (Staus, 2011).

Secondly, Environmental characteristics refer to the features of the area surrounding a household, such as the distance from an individual to fast-food restaurants, non-fast-food restaurants, grocery stores, and the region a household is residing within. In their research about household store choice decisions and food acquisition patterns, Taylor and Villas-Boas investigate how policymakers can best incentivize households to change their dietary habits to be healthier. They do so by analyzing what food at home and food away from home outlets households prefer using the FoodAPS dataset and a mixed logit model. The authors find that low-income households have a greater willingness to pay for travel expenses to access superstores and fast-food restaurants rather than healthier stores such as farmer markets (Taylor and Villas-Boas, 2016). Furthering this idea that environmental characteristics influence dietary choice, Feather finds that improving store access by creating supermarkets that are close to SNAP² recipients result in a gain in welfare ranging from \$2 to \$8 per month (Feather, 2003).

² Supplemental Nutrition Assistance Program (SNAP) provides nutrition benefits to supplement the food budget of needy families so they can purchase healthy food and move towards self-sufficiency.

All of these literary sources and their findings should be considered when determining which factors are important determinants of whether a household eats healthy or not.

3 **Data**

To address the research question, the empirical section of this question will be based on the dataset of the National Household Food Acquisition and Purchase Survey (FoodAPS), sponsored by the United States Department of Agriculture (USDA). From April 2012 to January 2013, the FoodAPS captured information on all purchases of food by all household members, either for consumption at home or away from home, for 4,826 households during a week. In addition to the food acquisition, the survey captured information on factors expected to affect food acquisition choices including household composition, income, demographic characteristics of the household members, participation in food assistance programs, dietary restrictions, among others. Finally, FoodAPS stands out as it contains geographic information on the households, after which data on the availability of options and their proximity was captured.

Table 1 presents summary statistics on the main variables of interest for our analysis, grouped by household's dietary status. Households that claimed an excellent or very good dietary status have a larger average income than those that claimed worse diets. In addition, the dispersion of income follows the same behavior, indicating a willingness component in dietary decisions, independently of the level of income. Interestingly, units with worse dietary habits have more females as primary respondents and less share of married, probably capturing a larger frequency of single-parent households among poorer populations. In terms of food venues, the average household has around 70 fast food options and above 300 non-fast-food in a 5-mile radius of their house.

Table 1. Summary Statistics by Household's Diet Status

Variable	Excellent	Very Good	Good	Fair	Poor
HH size	3.24 (1.63)	3.34 (1.53)	3.5 (1.54)	3.58 (1.64)	3.28 (1.73)
Avg Income	4.5 (4.02)	5.11 (4.85)	4.18 (3.69)	3.41 (2.89)	3.33 (2.79)
Female	0.69 (-)	0.78 (-)	0.77 (-)	0.8 (-)	0.8 (-)
Married	0.59 (-)	0.61 (-)	0.52 (-)	0.45 (-)	0.36 (-)
Bachelor	0.19 (-)	0.2 (-)	0.14 (-)	0.08 (-)	0.09 (-)
Masters	0.12 (-)	0.1 (-)	0.06 (-)	0.03 (-)	0.03 (-)
Age 20-35	0.31 (-)	0.31 (-)	0.36 (-)	0.34 (-)	0.34 (-)
Age 36-59	0.41 (-)	0.43 (-)	0.48 (-)	0.53 (-)	0.53 (-)
Age 60-65	0.15 (-)	0.1 (-)	0.07 (-)	0.05 (-)	0.05 (-)
Fast Food Options (5 miles)	77.73 (85.4)	66.87 (73.75)	68.95 (75.17)	73.85 (76.64)	79.95 (79.41)
Non Fast Food Options (5 miles)	373.06 (603.73)	312.87 (540.8)	307.7 (506.68)	311.19 (451.5)	338.84 (494.9)
Nearest Distance FF	1.88 (3.7)	1.8 (3.18)	1.84 (3.32)	1.67 (3.13)	1.52 (5.18)
Nearest Distance Non-FF	0.85 (1.46)	0.86 (1.35)	0.88 (1.45)	0.78 (1.28)	0.68 (1.15)
SNAP	0.3 (-)	0.26 (-)	0.34 (-)	0.44 (-)	0.4 (-)
WIC	0.13 (-)	0.12 (-)	0.12 (-)	0.12 (-)	0.08 (-)

Note: Average Income presented in thousands of dollars. Standard deviations in parenthesis.

4 Empirical Strategy

This paper will exploit information on household dietary habits to analyze the determinants of having a healthy diet by estimating a multinomial choice model. With that objective, we construct an indirect utility function (U_{ij}) where i represents the household and j represents the household assessment of how healthy their diet is, ranging in five categories from poor to excellent. The indirect utility function constructed has the following structure:

$$U_{ij} = \alpha_j + ENV_{ia}\beta_{aj} + HH_{ib}\gamma_{bj} + PR_{ic}\delta_{cj} + FA_{id}\theta_{dj} + Z_{ie}\pi_{ej} + \varepsilon_{ij}$$

This implies that the utility of household i of maintaining a type of diet j , depends on variables representing the household's environment (ENV_{ia}), the household's characteristics (HH_{ib}), the

primary respondent³ characteristics (PR_{ic}), participation on food assistance programs (FA_{id}), and other variables Z_{ie} , including motivations of store selection, and opinions towards healthy food. The vector α_j and the matrices β_{aj} , γ_{bj} , δ_{cj} , θ_{dj} , and π_{ej} contain parameters for each of the aforementioned sets. ε_{ij} represents an idiosyncratic error term capturing unobserved determinants of utility. Under this indirect utility specification, the probability of household i of maintaining dietary habits j is:

$$pr_{ij} = \frac{\exp(\alpha_j + ENV_{ia}\beta_{aj} + HH_{ib}\gamma_{bj} + PR_{ic}\delta_{cj} + FA_{id}\theta_{jd} + Z_{ie}\pi_{ej} + \varepsilon_{ij})}{\sum_{j=1}^5 \exp(\alpha_j + ENV_{ia}\beta_{aj} + HH_{ib}\gamma_{bj} + PR_{ic}\delta_{cj} + FA_{id}\theta_{jd} + Z_{ie}\pi_{ej} + \varepsilon_{ij})}$$

Our key parameters of interest are captured in the environmental variables and the food assistance programs. The first set will be captured through the availability of non-fast-food options (farmer's markets, food retail stores, restaurants, etc.) and fast-food options within a reasonable reach to the household (5 miles), and the latter will be estimated by participation of the household on the Supplemental Nutrition Assistance Program (SNAP) and the Special Supplemental Nutrition Program for Women, Infants, and Children (WIC).

Finally, it is worth mentioning that given that our dependent variable is the result of a self-assessment, the estimation will represent the determinants of dietary habits to the extent that reported and effective dietary habits are aligned. However, the data shows a strong positive correlation between the Body Mass Index of the primary respondent, which supports the validity of the self-assessments.

5 Results

a. Household Characteristics and Demographic Determinants

The first specification of the multinomial logit excludes variables related to the environment and governmental programs. Table 1 presents the results of the demographic and household determinants of diet status, where every column contains the coefficients for a given alternative after setting good diet status as a reference category. The variables found to be significant

³ This survey selected the primary respondent as the main food shopper or meal planner in the household.

determinants were household size, average income of the household, gender, marital status, age, and education. Controls for the month of the interview and region of the household are included.

Average monthly income of the household increases the probability of better dietary habits and decreases the probability of poorer dietary habits in comparison to the reference category of a good diet. These results are aligned with the intuition that households with lower income face a trade-off between the quality and quantity of their food. Less intuitive are the coefficients estimates of household size, which indicates negative coefficients for categories on both extremes (Excellent and Poor) and, thus, favoring central categories.

Regarding demographic characteristics, Table 1 indicates that households with a female primary respondent are more prone to fair or poor diets in comparison to the reference category. However, these results are only significant under a 10% significance level. Primary respondents who have completed a bachelor's or master's degree are more likely to have an excellent or very good diet status, indicating that education is a significant determinant of diet status. Finally, primary respondents between 20 and 59 years of age are, in general, less likely to have better diet status than the reference category.

Table 2. Household and Demographic Characteristics of Diet Status

	<i>Category:</i>			
	Diet Status of the Household			
	Excellent	Very Good	Fair	Poor
Intercept	−1.491** (0.721)	−0.942** (0.460)	−0.900** (0.396)	−3.618*** (1.001)
HH size	−0.201*** (0.057)	−0.003 (0.029)	0.070** (0.028)	−0.174** (0.069)
Avg Income	0.009 (0.018)	0.046*** (0.011)	−0.040*** (0.015)	−0.066* (0.035)
Female	−0.051 (0.159)	0.104 (0.101)	0.203* (0.108)	0.461** (0.234)
Married	0.468*** (0.150)	0.318*** (0.090)	−0.143 (0.092)	0.001 (0.188)
Bachelor	0.220 (0.195)	0.396*** (0.117)	−0.271* (0.144)	−0.492 (0.326)
Masters	0.642*** (0.245)	0.453*** (0.164)	−0.638** (0.250)	−0.750 (0.599)
Age 20 - 35	0.137 (0.242)	−0.768*** (0.144)	0.328* (0.183)	1.001** (0.421)
Age 36 - 59	−0.422* (0.240)	−0.727*** (0.136)	0.462*** (0.177)	0.710* (0.414)
Age 60 - 65	0.486* (0.286)	−0.113 (0.184)	0.420* (0.245)	1.429*** (0.473)
Observations	3,814		R ²	0.062
Log Likelihood	−4,753.75		LR Test (df = 88)	625.165***
Region Controls	Yes		Month Controls	Yes

Note:

*p<0.1; **p<0.05; ***p<0.01

Details: Reference category is "Good". Avg Income is in Thousands of US dollars.

b. Environment and Policy Variables

Continuing with the empirical strategy, Table 2 shows the results on the environment and policy variables affecting dietary status after controlling for the variables presented in Table 1. The environmental factors represent the availability of fast-food and non-fast-food options in the proximities of the household and the distance to the nearest option of both fast-food and non-fast-food options. The policy variables are composed by participation in the Supplemental

Nutrition Assistance Program (SNAP) and the Special Supplemental Nutrition Program for Women, Infants, and Children (WIC).

The number of fast-food options in a 5-mile radius is estimated to significantly affect the household's probability of having a poor diet. However, it also seems to increase the likelihood of having an excellent diet, limiting possible conclusions. On the other hand, the number of non-fast-food options reduces the probability of the household having a poor diet compared to the reference category. Results are similar for the distances to the nearest option. Households are more (less) likely to have a poor diet the closer the house is to a fast-food option (non-fast-food), in comparison to the reference category.

Regarding food assistance programs, estimations indicate that households receiving benefits from the SNAP program are more likely to have a fair diet rather than a good diet. Nevertheless, the estimates are only statically significant for the Fair category. On the other hand, households receiving benefits from the WIC program are significant and present the expected signs. Households receiving WIC have a higher probability of having excellent or very good dietary habits and a lower probability of having fair or poor dietary habits in comparison to good dietary habits.

Table 3. Environment and Policy Variables

	<i>Category:</i>			
	Diet Status of the Household			
	Excellent	Very Good	Fair	Poor
Intercept	-1.125 (0.772)	-0.751 (0.484)	-1.276*** (0.421)	-3.990*** (1.065)
Fast Food Options (5 miles)	0.005** (0.002)	-0.0002 (0.001)	0.002 (0.001)	0.009*** (0.003)
Non Fast Food Options (5 miles)	-0.0002 (0.0003)	0.0001 (0.0002)	-0.0002 (0.0002)	-0.001** (0.0004)
Nearest Distance FF	0.046* (0.024)	0.003 (0.018)	0.018 (0.018)	0.092*** (0.025)
Nearest Distance Non-FF	-0.073 (0.070)	-0.048 (0.042)	-0.060 (0.042)	-0.245** (0.095)
SNAP	0.050 (0.176)	0.004 (0.013)	0.322*** (0.097)	0.102 (0.211)
WIC	0.0004** (0.0002)	0.0002* (0.0001)	-0.0002** (0.0001)	-0.001** (0.0002)
Observations	3,814		R ²	0.072
Log Likelihood	-4,702.51		LR Test (df = 112)	727.651***
Region Controls	Yes		Month Controls	Yes
Demographic Controls	YES			

Note:

Details: Reference category is "Good". Avg Income is in Thousands of US dollars.

*p<0.1; **p<0.05; ***p<0.01

Average Marginal Effects

Below, average marginal effects are presented for household and individual characteristics, environment factors, and policy variables. An increase in the household size by one member decreases the probability of having an excellent diet by 1.5 percentage points (p.p.), having its larger individual impact on this category. Variations of 1,000 dollars in the average income of the households increase its probability of having a very good diet by 1.0 p.p. and in detriment of having a fair diet (0.7 p.p.), while effects for other categories are close to zero.

Households where the primary shopper is a female have a probability of 3.6 p.p. smaller of having a good diet, increasing its probability of having a fair or poor diet. Marital status increases the probability of maintaining excellent or very good dietary habits by 5.0 p.p. and 2.4 p.p., respectively. In addition, indicators of high education level have a large marginal effect on the household probability of presenting excellent or very good dietary habits.

Availability of fast-food options has a limited marginal effect on household diet as an increase in 10 in the number of fast-food venues increases the probability of having fair and poor diets by 0.2 p.p. and 0.3 p.p., respectively. Non-fast-food options have opposite directions and are smaller by one order of magnitude. In reference to the distance to the nearest option, reducing by 1 mile the distance to the nearest fast-food option increases the probability of having a poor diet by 0.3 p.p.

Finally, participation in food assistance programs has a considerable marginal effect. Households receiving SNAP benefits are 5.0 p.p. more likely to have a fair diet than a better dietary status. This result is possibly due to the restriction imposed by the program of only being able to use benefits in SNAP authorized venues. As for WIC, participation in the program has a minimal marginal effect, despite being a statically significant determinant.

Table 4. Average Marginal Effects

	Excellent	Very Good	Good	Fair	Poor
HH size	-0.015	-0.003	0.005	0.016	-0.003
Avg Income	0.001	0.010	-0.001	-0.007	-0.002
Female	-0.009	0.008	-0.036	0.026	0.010
Married	0.024	0.050	-0.041	-0.029	-0.004
Bachelor	0.008	0.077	-0.010	-0.059	-0.015
Masters	0.037	0.092	0.012	-0.121	-0.020
Age 20 - 35	0.003	-0.170	0.038	0.091	0.038
Age 36 - 59	-0.021	-0.142	0.033	0.105	0.024
Age 60 - 65	0.021	-0.049	-0.054	0.061	0.020
FF Options (5 miles)	0.0002	-0.0003	-0.0005	0.0002	0.0003
Non-FF Options (5 miles)	-0.00001	0.00004	0.00003	-0.00002	-0.00003
Nearest Distance FF	0.002	-0.002	-0.005	0.001	0.003
Nearest Distance NonFF	-0.002	-0.003	0.017	-0.005	-0.007
SNAP	-0.001	-0.015	-0.034	0.050	0.001
WIC	0.00003	0.00004	-0.00000	-0.00005	-0.00002

6 Discussion

Our model results indicate that dietary decisions are not directly pinned down to a set of characteristics, thus, being associated with willingness to maintain a healthy diet rather than the ability to maintain it. Therefore, policy decisions aiming to tackle the rising obesity rates and additional health issues could focus on changing the perspectives that form dietary habits. This could be partially achieved by developing an advertisement campaign providing information to households on the long-term costs of following unhealthy dietary habits, proposing low-budget healthy meal plans that households in a restricted financial situation could follow, and sharing information on what constitutes a healthy diet. Policies that focus on the dissemination of information could change household's behavior by modifying their consideration sets.

Our results also indicate that households with non-fast-food dining options close by are less likely to have poor diets. Therefore, another avenue policymakers could take to improve the dietary choice of households would be to expand access to these non-fast-food eating options.

This could be done in several ways. One way would be to create a center akin to a farmers' market, where healthy food is sold to residents of the area weekly. Another way would be to pass legislation, like the Farm 2014 Farm Bill mentioned earlier, to help finance healthy food retail industries. It is also worth noting that our results corroborate the idea that expanding healthy food access to food deserts positively affects dietary outcomes.

7 Conclusion

This paper takes a multinomial logit approach to identify the determinants of dietary choices of households in the United States by a group of household and individual characteristics, environmental factors, and policy variables. The results of our research indicate that education, income, household size, age, marriage status, access to food assistance programs, and distance from households to fast food restaurants have a statistically significant effect on household dietary choice. However, the marginal effects of these determinants on dietary choices probabilities can be considered as limited. In consequence, policy actions should rather be focused on nudging household's behavior through changes in the consideration sets and increased availability of healthy food options.

There are some limitations of this paper. One limitation is that while we document dietary habits and how those change with the presence of certain factors, we have no information on the status of those factors in the past. A richer analysis would include the past attitudes of households towards healthy eating to see how dietary patterns evolve over time. Also, the available data does not allow us to estimate the effect of additional forms of food assistance, like food received by children in the school or adults in their works, which might represent a considerable fraction of food eaten by a household. Another limitation is that while we have a strong indication that respondents to the FoodAPS survey are telling the truth using BMI measurements, we cannot be certain that this is the case. Therefore, a more complete analysis would account for potential report biases by controlling for households that might be intentionally falsifying their reports in our analysis.

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