What is the "Western Pattern?" Refining Factor-Derived Dietary Patterns from the NHANES Food Frequency Questionnaire Using 24-hour Dietary Recall Data

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Jonathan L. Cass

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ABSTRACT

Meal pattern analysis is an emerging technique in nutritional epidemiology useful for identifying eating patterns associated with disease. Two meal patterns commonly found in large epidemiologic studies are the "Western" pattern, characterized by high intakes of red meat, eggs, refined grains, fried foods and added sugars, and the “prudent” or “healthy” pattern, consisting of fruits, vegetables, whole grains, and low fat food items. The Western pattern has become more common worldwide along with the chronic diseases associated with this eating pattern, including obesity, heart disease, type II diabetes mellitus and some diet-related cancers.

Factor analysis was used to determine major dietary patterns from 2005-06 National Health and Nutrition Examination Survey (NHANES) Food Frequency Questionnaire (FFQ) data. Variables were entered into factor analysis with three different grouping schemes. Individuals in the top quintile of each factor were considered to have the greatest adherence to a given pattern. The 39 category analysis provided a balance between simplifying output and retaining predictive value of different food types. Multiple logistic regression models were constructed to determine predictors from demographic and 24-hour dietary recall data, including total energy, food source, food groups represented, number of eating occasions, and breakfast skipping.

Men were more likely to follow the Western pattern, and women as well as older Americans were more likely to follow the healthy diet pattern. Mexican Americans and other Hispanics were much less likely, and black Americans

much more likely than other ethnicities to follow the Western diet pattern. There was a clear linear relationship showing increased likelihood of following the healthy pattern with each increasing level of education. High income groups were both less likely to follow the healthy diet pattern and less likely to follow the Western pattern when compared to all other income groups.

Increasing daily energy had a strong positive association with the Western pattern, and increasing dietary diversity was inversely associated with the Western pattern. Eating out at a restaurant or bar was associated with a lower likelihood of following the healthy pattern. A greater number of eating occasions was generally associated with a lower likelihood of following the Western pattern with the exception of the highest frequency snacking group (9-21 snack items per day). Individuals reporting only 1-2 snack items per day were about half as likely to follow the healthy pattern. Skipping breakfast was associated with an almost 1.5 times greater likelihood of following the healthy diet pattern.

These findings are potentially useful for identifying individuals at risk for disease, or targeting health promotion efforts to specific population subgroups. A short form scale based on these results may help to identify strong adherents of the Western dietary pattern in resource-limited settings.

INTRODUCTION AND PROBLEM DEFINITION

Burden of Obesity in US Adults

Obesity and cardiovascular disease (CVD) continue to be among the top public health priorities on the United States, with [1, 2]. Worldwide, the top two causes of death are heart disease and stroke. [3] Overweight is defined as body mass index (BMI) from 25 to 29.9, and obesity is BMI over 30. The proportion of obese individuals has more than doubled over the past 30 years and today about two thirds of US adults are overweight or obese. Incidence of obesity has been rising over the past several decades, with low income and minority groups being disproportionately affected across all age groups. One prediction in 2007 had 75% of adults overweight or obese and 40% obese by 2015, but rates have leveled off since these predictions were made.[4]

Poor nutrition is a modifiable risk factor well suited to public health intervention. Based on a comparison of diet patterns and health outcomes across several regions of the world, Iqbal estimated that 30% of myocardial infarction (MI) deaths worldwide can be attributed to poor diet [5]. Over the past several decades there has been an upward trend in overall Calories consumed, the amount of food eaten away from home, and food marketing [6-8]. During this time there have also been increases in the number of Calories eaten per day and the amount of dietary energy from saturated fat, cholesterol and added sugars among US adults. [9]

In a 2011 report the World Health Organization encourages steps to reduce chronic (non-communicable) disease including screening at-risk

individuals, due to the potential cost of chronic disease to the world's economies. Heart disease, cancer, lung disease and diabetes are among WHO top prevention priorities since they account for about 80% of non-communicable disease deaths and share common risk factors, including unhealthy diet. Preventive measures, health education, and screening are low-cost ways to address diet-related disease.[10] The disease burden of obesity and CVD fall disproportionately on low income individuals who may find nutrition messages difficult to assimilate or put into action, pointing to the need for appropriate health education messages and interventions tailored to these groups. [11]

CVD Epidemiology and Risk Factors

The immediate risk factors of CVD are well known, and there is also an increasing body of literature describing the social and behavioral determinants of CVD. Risk factors for heart disease are interconnected and include poor cholesterol profile, hypertension, diabetes, tobacco use, diet, heredity, and a lack of physical activity. Nutrition is an important CVD risk factor throughout the life course[12]. Low levels of HDL (“good”) cholesterol and high levels of LDL (“bad”) cholesterol are associated with heart disease. Additional risk factors include high blood pressure (hypertension) and diabetes. A diet high in cholesterol can also increase heart disease risk by raising blood cholesterol levels.

A model that takes into account all of the forces acting on the individual over their entire lifetime is essential when studying a chronic illness like CVD. Krieger's ecosocial theory with its concept of embodiment provides a useful

framework for enumerating the risk factors for CVD and understanding how individuals embody these risk factors in the form of CVD progression. The ecosocial framework also helps in determining who or what is accountable for the conditions which create these CVD determinants, and in describing the interplay between this accountability and the agency of the individual (the ability of the individual to make decisions and act in their own self-interest). Behavioral models are essential not only to understanding disease progression, but for formulating effective public health interventions. [13]

CVD develops due to a variety of physical environment factors along with factors relating to a person's culture, upbringing, education, and socioeconomic background. Low socioeconomic position in childhood has been shown to be related to higher CVD incidence later in life. [14] Atherosclerosis begins in childhood, around 5 to 10 years of age, and risk factors such as body fat distribution may be predictive of CVD risk in younger people [15, 16]. Autopsies on 2,800 individuals who died of external causes found precursor atherosclerotic lesions in 10-20% of 15 to 19 year olds, and this percentage increased to between 30% and 40% among 30 to 34 year olds. Associations of risk factors with the presence of early lesions began in the late teens in this sample. [17] This evidence serves as an illustration of embodiment as the physical manifestation of obesity and associated CVD progression as a result of disadvantaged background and low SES [14, 16, 18, 19].

Reducing the risk of CVD is one of the benefits of physical activity - moderate physical activity (brisk walking for 30 minutes on most days of the

week) is sufficient to be protective against chronic disease. [1] Weight loss in overweight and obese individuals has also been shown to reduce risk factors for CVD [16]. Over half of US adults do not get enough exercise to provide a health benefit, and almost one quarter are not active at all during their leisure time. [20] Any health recommendations related to diet must consider the balance between Calories consumed and caloric expenditure, and be aware of barriers to physical activity that may exist in the population of interest.

Dietary Measurement

The food frequency questionnaire or FFQ is the most common method used to estimate dietary intake for large epidemiologic studies. The structure of an FFQ typically consists of a list of food items organized by type with questions asking the respondent to recall how often they have eaten that item over a specified period, usually over the past week or month. The most used food frequency questionnaires in US dietary studies (Block and Willett) were developed based on national health surveys used to identify the most commonly eaten foods and the nutrient values associated with them. The items consumed in the highest amounts were used as the basis for the list of food items in the questionnaire [21]. After combining these data with information from a nutrient database, stepwise regression was used to identify the major dietary contributors for each nutrient [22]. Food frequency questionnaires are an economical choice for estimating dietary intake in epidemiologic studies, since the cost of administering an FFQ is much lower than the cost associated with collecting

information from diet records for a comparable number of individuals and period of time [23]. FFQs can also be used in modified forms, for instance to estimate food intake for a specific time period or to add or subtract specific foods depending on the research question or study population. In a study evaluating the Block FFQ among low-income black women, Coates [24] found that adding several regional and ethnic foods to the FFQ aided in identifying key contributors of several nutrients. Potischman [25] found that the original 100 item Block FFQ was comparable to a 60 item version in analyses of major nutrients obtained from 12 days of validation data.

The standard comparison measure for an FFQ is the diet record, in which a study respondent records all of their dietary intake, between a 24-hour and one week period[26]. Correlations between FFQ data and diet record data from validation studies show that data gathered from FFQs may not reflect true intake [27, 28]. The presence of an interviewer may aid recall and improve correlations with food record data (compared to a self-administered FFQ) [29]. While correlations between FFQ and diet records improve with an increasing number of records kept (days recorded), there is still room for substantial human error in reporting true intake [30].

Diet records may not be as prone to recall bias as FFQ results[26], but they may still be prone to bias due to over and underreporting foods based on social desirability[27]. The 24-hour dietary recall is less structured than an FFQ and allows for researchers to record any and all foods respondents ate in the last 24 hours, using a comprehensive list of food codes. Normally there are human or

computer assisted prompts that remind respondents of items they may have forgotten to report. This method also collects information such as snacking habits, meal frequency, and eating location that is not captured by many FFQs. Dietary recall data can be analyzed with nutrient values already calculated for certain foods to create an estimate of the nutrient intake for specific individuals or populations. Correlations between FFQ item data and information gathered from 24-hour diet recalls are generally in the range of 0.4 to 0.7 [21, 31]. This method also does not require that the respondent be literate, and can collect information on food preparation methods and how foods are eaten in combination. [32] The 24-hour recall method of dietary data collection is limited in that it is a "snapshot" of dietary data that may not be representative of true intake. Willett suggests that longer-term diet records (e.g. several days to a week) are more accurate in determining usual intake than 24-hour recalls, and may compensate for within-person variability [27].

Subar [33] suggests that 24-hour recall data can help complement data from FFQs, and that multiple 24-1hour measurements can further improve the correlations between these two types of data collection. Subar also proposes that FFQ data can be useful not as an absolute measure of nutrient intake but instead as an indicator of dietary patterns that appear in the diet record. "Using frequency data from an FFQ as covariates in statistical models directed at estimating usual intake of episodically consumed foods requires not that the frequency information be precise, but rather that it exhibit a strong and predictive relationship with 24-hour recall data with respect to an individual’s probability to consume a particular

food. If, in addition, it has a relationship with the amounts reported on a 24-hour recall, this might provide additional information."[33] According to Kant (2011), data from one day of intake as measured by a 24-hour recall "may be inappropriate for estimating the usual intake for individuals, estimations of nutrient adequacy, or the examination of population distributions of normal intake" but are considered appropriate for estimation of mean usual intakes of groups. [34]

Biomarkers are another method by which dietary intake can be indirectly measured, and normally involves laboratory analysis of blood samples for common food metabolites and individual nutrients. Dietary measurement using biomarkers is potentially a very effective method for validating dietary questionnaire data because nutrient values determined this way should provide completely independent verification of nutrient values calculated based on questionnaire responses. However, between-person variation in how nutrients are absorbed and metabolized can cause variation in biomarker data which is independent of actual nutrient intake. Day to day variation in biomarker levels can also make any inference to actual intake difficult, and there may also be measurement error associated with obtaining the laboratory values themselves. No reliable biomarkers exist yet for some nutrients such as total fat or total carbohydrate. Finally, biomarker analysis for measuring nutrient intake suffers from the same shortcoming of the diet record method, namely the inability to capture representative or usual food intake. [35]

The "method of triads" can potentially mitigate the biases inherent in the diet measurement methods described above. In this method, nutrient data collected from an FFQ, a diet record, and biomarker data are compared to estimate true dietary intake. This method assumes that measurement errors from each method are uncorrelated with each other, which may not always be the case when comparing FFQ and food record data collected from the same respondent.[35] While none of the methods listed above can provide a completely accurate picture of diet, Barrett-Connor (1991) observes that "neither complete accuracy nor reproducibility is essential to produce useful research on...diet and disease. Excessive certainty about the value or nonvalue of any method of diet assessment, or the truth of any diet-disease association or its absence, should be avoided. Thoughtful comparisons of the results of different studies are necessary and often demonstrate considerable consistency despite the limits of dietary assessment." [36]

Dietary Patterns and Disease

Measuring the effect of diet on health is complicated by the lack of reliable measures of diet, the clustering of nutrients in foods, and the fact that foods are eaten in combination. Studying meal patterns may be more productive than looking at individual nutrients, given the fact that nutrients can interact in ways not easy to predict when combined in meals. Determining the diet-disease relationship from a meal perspective may result in dietary recommendations more easily interpretable by researchers and the public.[35, 37] Dietary pattern

analysis is becoming increasingly common in epidemiologic studies as a way to measure the effects of combinations of food on health, and not merely the effect of individual nutrients.[38]

An investigation of trends in dietary quality from 1999 to 2010 in the US adult population using NHANES data found that Average Healthy Eating Index (AHEI) scores increased from 39.9 in 1999 to 2000 to 46.8 in 2009 to 2010 (linear trend $P < .001$). More than half of the increase in healthy eating behavior was a result of reduction in trans fat intake. Statistically significant drops in sugar sweetened beverage intake and juice intake were also observed. Family income and education level were positively associated with healthier eating, and the gap between low and high socioeconomic status grew during that period. Despite these improvements, overall diet quality was poor. [39, 40]

The Western pattern is one of the most common patterns found in large scale epidemiologic dietary studies [41-45]. The Western dietary pattern typically consists of meat, eggs, refined grains, and processed foods, while a "prudent" or "healthy" pattern typically includes fruits, vegetables, nuts, whole grains, and low fat items. The Western pattern has been associated with increased heart disease risk[37, 41, 45], while the prudent dietary pattern has been associated with a decreased risk[37, 42, 44, 46-48]. Components of the Western diet such as animal fat, refined sugar, and eggs have a clear association with CVD, [49-51]. A prudent dietary pattern is typically associated with female gender, as well as higher income and education. [41, 52-55] The Western dietary pattern may have initially emerged as a response to human adoption of farming and animal

husbandry roughly 10,000 years ago. The adoption of this new diet may have occurred abruptly enough in an evolutionary sense to not allow the human genome to adjust. The widespread adoption of this diet, along with other factors such as a more sedentary existence has been associated with disease.[56] There is also evidence of a global convergence towards adoption of the Western diet, which has large implications for obesity rates in developing countries.[38] A standardized case-control study of over 5000 cases of acute MI from 52 countries found a positive association between acute MI and being in the top two quartiles of intake for the Western dietary pattern [5]. The Western pattern has been associated with cardiovascular disease and cancer, while the prudent pattern has been shown to be protective against disease.[38]

Major Food Groups Represented

In this analysis, the additional information on diet patterns obtained from dietary recall data include food source, meal frequency including snacking and breakfast skipping, total meal energy, and total food groups represented. Each of these variables was chosen because of its potential importance in adding to the current understanding of dietary patterns. A review of 24-hour diet data in NHANES II data revealed that only 35 percent of whites and 25 percent of blacks consume foods from five major food groups (meat, grain, dairy, fruit, and vegetable) on a daily basis. Almost 70 percent of adults did not eat foods from one or more of these food groups. Any eating pattern that completely omitted even one food group was associated with lower than recommended intake of

certain vitamins and minerals. [57] Fats and sweets were excluded since the five major groups were meant to represent only foods contributing significantly to nutrient intake. [57, 58] National nutrition surveys have shown that respondents not consuming all five food groups are not receiving a nutritionally adequate diet [59-61]. Kant (1991, 1993) found that nutrient RDA levels were met only for eating patterns in which all five food groups were represented.[58, 62]

Food Source

According to the National Restaurant Association, almost half Americans' food budgets are spent outside the home [63]. This is of concern given that people tend to eat more Calories when eating out [33, 63]. Eating at fast food establishments in particular is associated with higher total energy intake, lower micronutrient intake, and lower intake of fruits and vegetables [64]. Recent national surveys of household food expenditures and food consumption show a recent trend of an increasing proportion of total Calories obtained away from home and at fast food outlets in particular [65, 66]. Adding information on food source to already established dietary pattern data is of potential value in identifying individuals at risk for disease.

Snacking and Meal Frequency

To date there is no consensus on the definition of snacking, although self-identified snacking occasions may be one of the more consistent measures over time.[67] For this analysis any eating occasion

marked as a snack by the respondent was counted as a snack, with each food item counting as a separate snacking occasion. Snacking between meals and eating very infrequently (only one or two times per day) have all been associated with type II diabetes mellitus[68] and snacking is also associated with higher caloric intake and obesity [49-51]. Eating three meals per day including breakfast had the lowest risk for type 2 diabetes mellitus in the Health Professionals Followup Study [68]. Snacking may not always consist of consuming “empty calories” and can have advantages for weight control [69]. In some individuals snacking may contribute significantly to nutrient intake or be part of a pattern of high calorie consumption tied to a high level of physical activity [70]. A 1997 review found that "nibbling" or frequent snacking throughout the day produced comparable energy intake to a pattern consisting of fewer meals [71]. Although one study of NHANES I data found no association between meal frequency and weight gain [72], an analysis of NHANES III data (1988 to 1994) showed an increase in eating frequency, snacking, and the quantity and energy density of foods, associated with increasing rates of obesity in the US population[73]. An analysis of the Health Professionals Followup Study found Increased eating frequency (above three meals per day) increasing the risk of 5 kg weight gain over 10 years of followup.[74]

There is evidence of increasing snacking among US adults between 1977-2006 [67], and that energy consumed on average for each snacking event has been increasing over the last 20-30 years [67]. No

significant changes in snacking behavior or number of eating occasions was observed in a review of consecutive NHANES cohorts from 1971 to 2002, although meal quantity and energy density appeared to increase starting with the NHANES III cohort (1988-1994), roughly in parallel to increasing obesity rates beginning at that period. [73]

Total Energy

Of all dietary factors, the number of eating occasions per day and increased portion size have contributed the most to increases in daily energy intake among US adults over the past 30 years[75]. In this cohort total energy per day was measured in kcal/day as calculated in dietcalc results. A simulation model of 24 million adults found that a 100-kcal reduction in daily intake would eliminate about 71 million cases of overweight/obesity and save $58 billion annually. Changes in diet at the population level can improve health and reduce annual national medical expenditures by $60 billion to $120 billion. A model such as this can be used in setting priorities for public health messaging and guidance [76].

Breakfast Consumption

The USDA has used NHANES data to determine breakfast and snacking patterns for various groups. About 80 percent of Americans eat breakfast on a given day. Teens, young adults, African Americans (70%), and lower income people (74%) are more likely to skip breakfast. About three quarters of

respondents ate breakfast at home, the remaining 25% ate breakfast out.[77] While the nutritional content of the average US breakfast seems to have improved since 1965, breakfast consumption overall has declined from 86% to 75% between 1965 and 1991 among US adults [78]. Breakfast consumption is more common with increasing age [78]. Breakfast composition and nutrient profiles also vary widely between sociodemographic groups [79], underscoring the importance of a more thorough understanding of how dietary patterns differ across population subgroups and how health messages should be tailored to these groups.

Higher breakfast energy density is associated with higher energy density and increased fat intake for other meals throughout the day, along with less micronutrient intake and fewer food groups represented overall. Higher BMI was associated with breakfast energy density in men, and with non-breakfast energy density in women. [80] Breakfast consumption has been associated with healthy nutrient intake patterns and improved health status among children, adults and the elderly [78, 81-87]. Breakfast consumption has also been inversely associated with both type 2 diabetes mellitus risk and 5 kg weight gain over 10 years among men in the Health Professionals Followup Study. [68, 74]

Dietary Pattern Analyses

Many studies of nutrition and diet commonly look at the relationship between the intake of specific foods or nutrients and health indicators, but the effects of dietary patterns on health are less clearly understood [35].

Mathematical pattern analysis is a common technique for analyzing data from food frequency questionnaires. A major challenge in studying dietary patterns and disease risk involves choosing an appropriate quantitative method to identify eating patterns. Methods that are *a priori* assume that underlying patterns exist in the data, and variables are designed with the assumption that these patterns will be uncovered by analysis. *A posteriori* approaches have no initial assumptions regarding what specific patterns that might be uncovered (e.g. Western, Healthy, Mediterranean). Exploratory factor analysis (FA) is the most common *a posteriori* method for dietary data analysis[88]. FA reduces data from a large set of responses and uncovers major dietary patterns by identifying item responses that are highly correlated with each other, uncovering "latent variables" in the dataset. These latent variables are not measured directly but represent respondent characteristics described by groups of variables in the dataset. These latent variables, or factor patterns, can then be correlated with disease prevalence or biomarkers in cross-sectional studies. When this type of analysis has been performed on FFQ data, typically only a few major factor patterns emerge [89] which are named by investigators based on an overall subjective impression of the items in that pattern (e.g. “high fat,” vegetarian” etc.).

In a review of 30 meal pattern analysis studies that used either factor analysis, cluster analysis, or a diet index (two *a posteriori* methods and one *a priori* method, respectively), Togo et al. found little correlation between dietary findings and obesity, suggesting that a lack of consistency or gold standards for these methods may have been responsible. They also reported similarities

between meal patterns produced by the different methods, concluding that there was a "reasonably good consistency of the factor and cluster analysis method[s]" across studies. They also found that found that the more food items were in a factor-derived pattern, the less variance among individuals was explained by that factor. [90] A separate study comparing three methods for determining dietary patterns including Principal Components Analysis (PCA), partial least squares regression and reduced rank regression found that all three methods uncovered patterns associated with decreased risk of heart attack. PCA and partial least squares methods were more likely to find patterns associated with increased risk, uncovering patterns that included nutrients not previously associated with heart disease. [91]

Exploratory factor analysis involves several arbitrary but important decisions, including the grouping of individual food items into categories, determining the number of facto rs to extract from the analysis, which rotation method to use, and how to label the resulting components [92, 93]. Confirmatory factor analysis [58] can be used to examine the robustness and goodness of fit of factor structures derived from the conventional or exploratory factor analysis.[37]

RESEARCH OBJECTIVES AND SPECIFIC AIMS

The overarching goal of this project is to define the major US dietary patterns (as determined by statistical pattern analysis of food frequency questionnaire (FFQ) data from the National Health and Nutrition Examination Survey (NHANES) in terms of eating habits, not just as groups of individual food

items. This will be accomplished by first using factor scores to sort individuals into top quintiles for each major FFQ factor pattern, then using 24-hour dietary recall data to further define the individuals in these top quintiles in terms of eating habits (total energy per meal, meal location, total number food groups represented, number of meals per day, number of snacking occasions, and breakfast skipping).

To date, the Western and prudent patterns have been described in terms of food groupings only, rather than dietary behaviors. Because these patterns have typically been described based on FFQ data alone, little is known about the behavioral aspects of these patterns, including snacking, meal timing, meal skipping, and grouping of food items. Defining these patterns in terms of dietary habits as well may provide useful information for health screening and identifying individuals at risk for disease. Kerver (2003) found major NHANES dietary patterns, including the Western and prudent patterns, to be correlated with biomarkers associated with CVD risk, and suggests that measuring diet patterns by food intake only without taking dietary habits like meal and snack patterns into account may leave out important diet pattern information.[45, 94]

Previous pattern analyses of NHANES data have examined meal and snacking patterns across several consecutive cohorts [73], associations between dietary patterns and nutrient or energy intake [95], associations between dietary patterns and disease [35, 45], adherence to nutritional guidelines [73, 96], and the relationship between snacking and overall nutrient intake [95]. No studies currently define major factor-derived NHANES FFQ dietary patterns based on

24-hour recall data. By further describing these major patterns using 24-hour data, additional information should emerge on which of the major food groups are represented in the diet, whether respondents skip meals, snack, or eat away from home, and the total energy per meal. These additional associations should be of interest to nutrition researchers and health professionals seeking to identify individuals at risk for disease.

In a study comparing factor-derived patterns in FFQ and diet record data, Hu et al.[97] described a "prudent" pattern consisting of whole grains, fruits and vegetables and a "Western" pattern consisting of refined grains, dairy products, meat and eggs. Hu found high reliability (0.67) between two FFQ administrations and good reliability (0.45 to 0.74) between FFQ results and diet records for these two patterns. The analysis however only accounted for 20% of the variability among respondents[97]. Rather than determining patterns from FFQ and diet record data separately and then comparing them, this analysis uses diet record data to describe respondents of each major factor-derived FFQ pattern in terms of eating habits (total eating occasions including snacking and breakfast skipping, food source, total energy per meal, and major food groups represented). Developing an FFQ with added questions on these additional variables may account for a greater proportion of between-person variation. With this information, scales might be developed that measure the degree of the respondent's adherence to the dietary habit aspects of the Western FFQ pattern (or other common patterns discovered based on factor analysis of FFQ data). Short-form scales that can quickly identify individuals following dietary habits

associated with CHD risk may be a more efficient screening technique than administering a 200+ item FFQ.

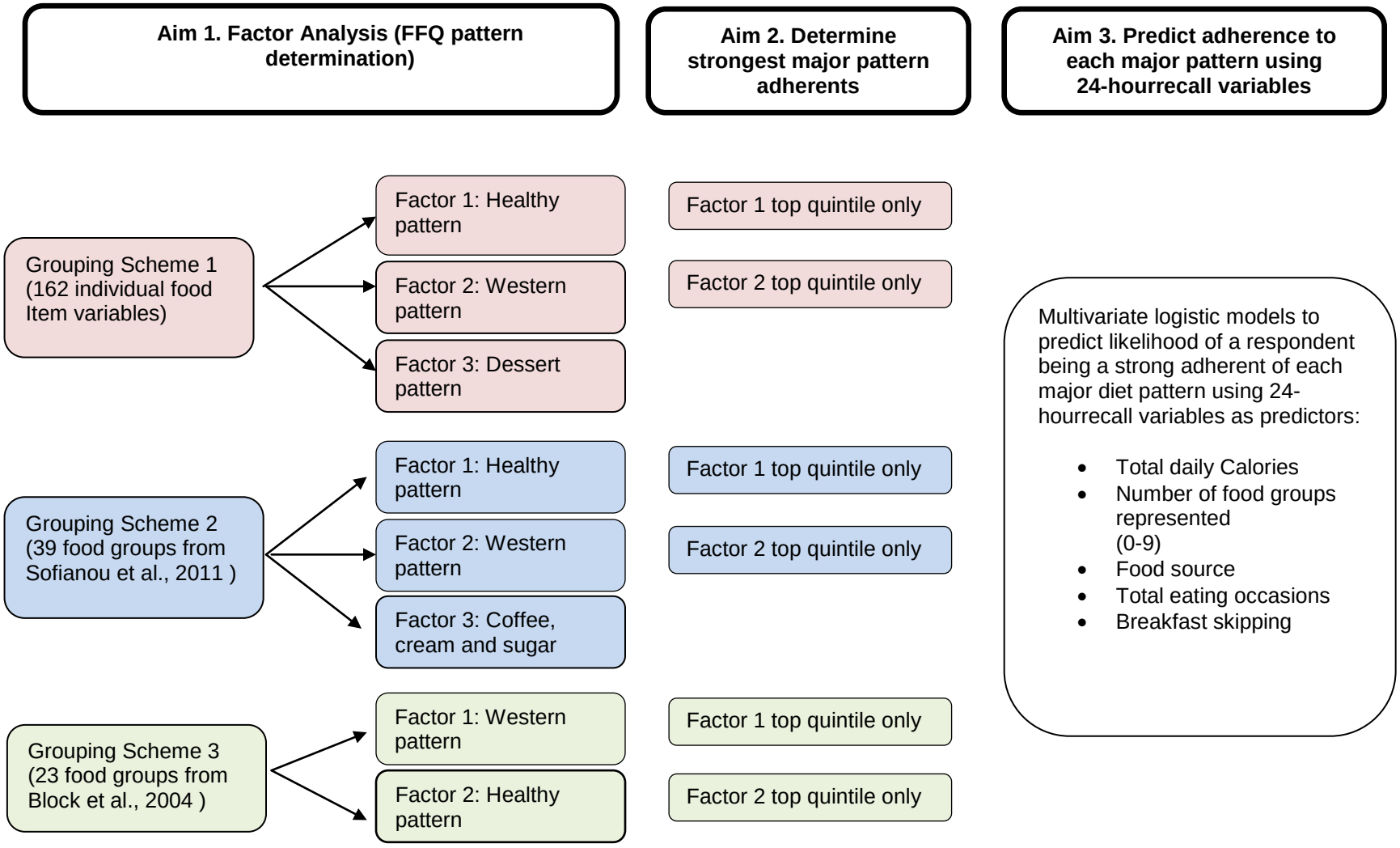
Figure 1 describes the analytic framework. The first aim is to determine major dietary patterns for FFQ responses in the 2005-06 NHANES cohort. Factor analysis will be performed with three variable grouping schemes to compare the effect of grouping on resulting major dietary patterns. The first hypothesis is that major FFQ dietary patterns from the 2005-06 NHANES will be similar to the healthy and unhealthy patterns previously described in the literature. Secondly, variable grouping schemes will have little effect on major factors uncovered, although simplified groupings (fewer variables per group) will explain more variance in the dataset. The respondent groupings from this step of the analysis will be the basis of later analyses that will attempt to describe these patterns in more detail based on 24-hour dietary recall data. Typically, the major patterns emerging from population level data include a high-fat or “Western” pattern and a “prudent” pattern consisting of healthier items. The names given to these patterns are subjective and depend on the food items in each pattern.

The second aim is to identify individuals in the highest quintile for each response pattern (the strongest adherents of each pattern) and describe demographics for each subgroup. Grouping by quintiles is a way to identify only the strongest adherents of a food pattern. Demographic variables will include age, race, gender, household income, marital status, and education level.

The third aim is to create multivariate models predicting the degree of respondent adherence to each major meal pattern using dietary habit data from

24-hour recalls as predictors (major food groups represented, meal size (total energy), number of eating occasions, and meal location). We expect to find that Western/high fat pattern eaters will be more likely to have unhealthy eating habits such as breakfast skipping, larger total energy per meal, and eating away from home. Associations between demographic subgroups and eating behaviors could be instructive in identifying individuals at risk for disease.

Figure 1. ANALYTIC FRAMEWORK



STUDY DESIGN AND METHODS

Study Population and Data

This is a cross-sectional analysis of data from the 2005-06 NHANES cohort. These data are publicly available from the National Center for Health Statistics website (http://www.cdc.gov/nchs/nhanes.htm). The National Health and Nutrition Examination Survey (NHANES) began in the early 1960s as a series of surveys designed to assess the nutritional status of all non-institutionalized US residents. NHANES I, II and III ran until 1999 when NHANES became continuous with data releases every two years. NHANES currently has a multistage, stratified probability design using counties, blocks and households with oversampling of certain population subgroups.[98] NHANES screens 15,000 households nationwide and selects 3500 from 15 counties or clusters of counties during each survey cycle. From this sample approximately 5000 are selected to be a representative sample for interviewing and examination. NHANES uses in-person interviews, written surveys, and physical examinations to collect data on demographics, health status, diet, and physiological measurements [99]. Data from the 2005-06 NHANES cycle will be used for this analysis because is the most recent cycle for which information from both the food frequency questionnaire (FFQ), and individual food files (IF) are available for the same cohort.

The 2005-06 NHANES FFQ queries frequency of consumption of 216 different foods by season and food subtype during a 12-month period (20,21). All

English or Spanish-speaking examinees 2+ years of age who completed at least one 24-hr dietary recall interview were eligible to complete the FFQ component. [99] The FFQ is designed to collect information on general dietary patterns, not absolute food or nutrient intake [33, 99]. Frequency values collected are multiple choice categories with units varying between "per month," "per week," and “per day” depending on the food item.

Raw FFQ responses are standardized by the Centers for Disease Control and Prevention using the Dietcalc Analysis program developed by the National Cancer Institute (version 1.4.3, 2005, National Cancer Institute, Applied Research Program, Bethesda, MD) so that consumption of each of 216 separate food items is represented as an average annual daily frequency. For example once-daily consumption would be given a value of 1, while a response of one time per month is represented by 1/30 days = 0.033 (20,21) (see

Figure 2). The FFQ also asks about seasonal consumption of certain foods, such as fruits and vegetables (e.g. in season and out of season). The FFQ also asks about the proportion (reported as fractions) of the time certain types of foods were eaten over the past 12 months such as sugar-free soft drinks, whole grain foods, and light, low-fat or fat-free varieties of foods (see Appendix). [100] Dietcalc algorithms create a continuous variable for each food item, allowing FFQ data to be input into a factor analysis.

Figure 2. Algorithms from Dietcalc software for computing average annual daily frequencies

Foods:
Never= 0
1-6 time per year = 0.01
7-11 times per year = 0.028
1 time per month = 0.033
2-3 times per month = 0.08
1 time per week = 0.14
2 times per week = 0.29
3-4 times per week = 0.5
5-6 times per week = 0.79
1 time per day = 1
2 or more times per day = 2

Beverages:
Never = 0
1 time per month or less = 0.03
2-3 times per month = 0.08
1-2 times per week = 0.21
3-4 times per week = 0.5
5-6 times per week = 0.79
1 time per day = 1
2-3 times per day = 2.5
4-5 times per day = 4.5
6 or more times per day = 7

Coffee, tea, and additions to coffee and tea:
None= 0
Less than 1 cup per month = 0.02
1-3 cups per month = 0.07
1 cup per week = 0.14
2-4 cups per week = 0.43
5-6 cups per week = 0.79
1 cup per day = 1
2-3 cups per day = 2.5
4-5 cups per day = 4.5
6 or more cups per day = 7

Diet and sugar-free soda proportions:
First proportion (how often soda was diet or sugar-free) = P1
Second proportion (how often soda was caffeine-free) = P2
Multiplier used for:
Value for diet, caffeine-free soda = P1 * P2
Value for diet, caffeinated soda = P1 * (1 – P2)
Value for regular, caffeine-free soda = (1 – P1) * P2
Value for regular, caffeinated soda = (1 – P1) * (1 – P2)

CDC, 2013

NHANES dietary recall data are collected via a series of questionnaires and by the collection of diet record data with the assistance of an interviewer. Since 2002, 24-hour dietary recall data from NHANES are collected twice; the first interview is collected in-person at an NHANES Mobile Examination Center (MEC) and the second interview is collected by telephone 3 to 10 days later and is completed with the assistance of an interviewer who prompts respondents about commonly forgotten foods. The Automated Multiple Pass Method (AMPM) is designed to elicit as much detail as possible about the respondent's food

intake over the past 24 hours including food item description, amount, day of the week, time the food was eaten, and where the food was eaten. The interviewer provides prompts about commonly eaten foods in case the respondent has forgotten any items. Respondents self-identify the type of eating occasion, including breakfast, lunch, dinner, snack, drink, and extended consumption categories. Data on the time of each eating occasion allows for information on meal size, snacking behavior, and meal skipping to be analyzed. The individual foods file (IF) generated from this process includes the coded diet record responses from two days of 24-hour dietary recall data using over 6900 individual food codes. The automated multiple pass method used for the NHANES 24-hour dietary recall is the preferred method for obtaining accurate diet information from a diverse study population. The open-ended format allows for respondents to list foods alone or in combination, and based on any eating occasion [35].

Data Preparation

2005-06 NHANES data were downloaded from the NHANES website (CDC, National Center for Health Statistics). Two datasets were used, one for FFQ data and one for 24-hour dietary recall data. Day 1 dietary recall data were collected in person at the Mobile Examination Center, and day 2 dietary recall data were obtained by phone several days after the initial interview. Only respondents with a completed FFQ as well as day 1 of the 24-hour dietary recall data were eligible for this analysis. Only day 1 data were used due to the

increased reliability of data obtained from the in-person interview.[101] Data were analyzed using SAS (version 9.3, Sas Institute Inc., Cary, NC).

Variables with as much as 3% missing responses were found in the FFQ dataset. These were not considered to be problematic as Dietcalc software counts missing FFQ responses as zero (item not consumed). Data missing due to skip patterns was also coded as zero intake; Willett [35] and Caan [102] found that blank responses usually correspond to foods not eaten (as opposed to items that a respondent overlooked or an error in filling out the FFQ). The study sample consisted of 2807 adults aged 18 years or older with an FFQ 90% complete. This criteria for FFQ completeness was set in order to prevent response bias.

FFQ data may be better suited for factor analysis than 24-hour recall data because FFQs capture dietary intake over a long period, and generally have more normal variable distributions and fewer zero values than 24-hour recall data. Factor analysis provides more robust results when using data from continuous variables. [35, 100].

Based on dietcalc output the highest average annual daily frequencies were found mainly for beverages, especially tea, the highest value being 14 servings per day. Likewise, the total number of Calories consumed per day as reported in dietary recall ranged from zero to over 8000. Individuals with total caloric intake below 200 Calories per day were excluded as not likely to contribute meaningful pattern data in other response categories (e.g. food groups represented, food source). Respondents with these values were not excluded

from the dataset given that these values may be high but are plausible, especially for a single day of intake.[103]

Typically in FFQ datasets, items with few responses tend to be heavily skewed to the right, with most responses at the lower end (i.e. the item was consumed "never" or “several times per year” by most of the study sample). A comparison of factor-derived dietary patterns between cohorts in four European countries showed that factor-derived patterns were robust in terms of number and type of major factors extracted regardless of energy adjustment and distribution of variables [89, 104].

According to Willett [35] energy adjustment is essential in studies of diet-disease relationships because determining the relationship between absolute nutrient consumption and disease states is too easily confounded by between-person differences in physical activity, body size, and metabolic efficiency. However, energy adjustment does not appear to be essential in studies that do not look at diet-disease relationships and focus only on defining the dietary patterns themselves. When respondents are grouped by FFQ meal pattern and information from 24-hour records is matched with the individuals in that group, total energy per meal may be an important descriptive aspect of a given dietary pattern. In a factor analysis of FFQ data collected from over 12,000 British women, adjusting for energy intake did not have a strong effect on resulting dietary patterns [105]. Based on these findings, the variables in this analysis will not be log transformed or energy adjusted.

Weighting

NHANES datasets include sample weights to account for nonresponse, and under-represented population subgroups. This analysis is not making population level generalizations regarding diet patterns and disease risk, but final models created with and without sample weights will be presented.

Aim 1: Variable Grouping and Factor Analyses

The first research aim is to determine major dietary patterns in the FFQ data. In this analysis, the effect of FFQ variable grouping on the results of factor analysis was tested by using three different schemes, either ungrouped (216 items) or grouped into schemes shown in Tables 1 and 2 (39 categories and 23 categories). The 39 food groups in the intermediate grouping were based on a similar analysis conducted by Sofianou et al. [100], and the smallest grouping scheme consisted of 23 groups as used by Block et al. in an analysis of NHANES III and NHANES 1999-2000 data to determine what foods contribute most to energy intake.[106] [98, 100].

Table 1. 39 food groupings representing all variables in the 2005-06 NHANES FFQ (from Sofianou et al., 2011).

1. Red meat
2. Processed meat
3. Desserts
4. Pasta
5. Potato, fried
6. Pizza
7. Salty snacks
8. White bread
9. Poultry, fried
10. Fish, fried
11. Potato, not fried
12. Sweetened beverages
13. Candy
14. Dairy, full fat
15. Alcohol
16. Green vegetables
17. Fresh fruit
18. Yellow vegetables
19. Other vegetables
20. Salad dressing
21. Dried fruit
22. Cereals
23. Nuts and seeds
24. Fish, not fried
25. Poultry, not fried
26. Juice
27. Bread, whole wheat
28. Dairy, low-fat
29. Tomato/tomato-based products
30. Beans/legumes
31. Tortilla
32. Oil
33. Rice
34. Soups
35. Added sugar
36. Coffee
37. Butter/margarine
38. Tea
39. Eggs

Table 2. 23 Collapsed Food Groups (from Block, 2004)

1. Alcoholic beverages
2. Beans, peanuts
3. Beef, pork
4. Bread, rolls, crackers
5. Breakfast cereal
6. Chicken, fish
7. Coffee, tea
8. Dairy
9. Drinks like Koolaid
10. Eggs
11. Fats & oils
12. Fruit, juice
13. Ketchup & other sauces
14. Meal replacements, bars
15. Mixed dishes
16. Other foods
17. Pasta
18. Rice and other grain products
19. Salty snacks
20. Soft drinks
21. Sweets, desserts
22. Tofu, soy milk
23. Vegetables

Previous studies using factor analysis on NHANES FFQ data have typically used food groupings to simplify the factor structure [45]. However, the grouping scheme used on individual questionnaire items before entering them into a factor analysis procedure may affect resulting dietary patterns[104] and the amount of variance explained by the resulting factors [107]. McCann found that grouping schemes with fewer items per category explained more variance in the dataset, but suggested that using groupings with greater detail may uncover correlations between infrequently consumed items and major dietary patterns. [108] According to Kerver "The inclusion of unrelated variables in a factor analysis can have the effect of redefining factors because of shared extraneous variance, whereas the exclusion of variables to simplify the factorial structure can lead to erroneous conclusions. Fine-tuning the food groups entered into a factor analysis may improve associations between dietary patterns and markers for disease risk." [45, 98]. In a 2004 review of over 90 studies using factor or cluster analysis to analyze diet patterns, most studies collapsed foods into categories unless there were less than 25 items to begin with [89]. In another review, between two and seven factors were typically included and explained between 20% and 59% of variance in the dataset. [98]

If patterns emerging from the analysis are similar across variable groupings, the grouping with the smallest number of FFQ variables (most food items per variable) may form the basis for the development of a short-form FFQ that captures a similar amount of variability in the population as the full FFQ.

Factor Extraction and Rotation

When analyzing the output of a factor analysis, the number of factors extracted normally depends on factor interpretability and the amount of variance explained by each factor. [108] Martinez [92] argues that the arbitrary nature of designing factor analyses results in unavoidable judgments about how factors are created and interpreted, and there is no way to ensure that a given factor contains all potentially relevant variables. While most researchers choose an eigenvalue cutoff of 1 or 1.25, there is no standard value, and patterns resulting from a factor analysis may or may not make intuitive sense. During rotation, the variance explained by a given set of factors is only redistributed. This analyses used an eigenvalue cutoff of 1.25, similar to previous factor analyses of NHANES data [45, 100]

Factors with eigenvalues above 1.25 were retained for orthogonal rotation to maximize factor loadings and aid interpretability of resulting factors. Factor loadings from the major food patterns from each grouping were then used to identify the top quintile (the strongest adherents) of each pattern (see Figure 1). Variables from 24-hour dietary recall data were used as predictors in a multivariate logistic regression model to determine the likelihood that a respondent with certain dietary habits is a strong adherent to one of the major dietary patterns.

For this analysis, only the major response patterns (factors) for each of the three grouping schemes were carried forward to the next step of the analysis, which involved creating logistic models to predict respondent adherence to each

pattern using 24-hour dietary recall data. As in the examples cited above, an eigenvalue cutoff of 1.25 was used along with inspection of a scree plot to determine how many factors should be retained for rotation. All major factors emerging from each of the three grouping schemes were named based on the foods contained in each pattern. Names are assigned to these subgroups subjectively (Western, healthy etc.) and were determined by the variables (food items) that load highest for each pattern. When appropriate these pattern names are similar to those previously reported in the literature [41, 97]. Using an orthogonal rotation resulted in uncorrelated factors, maximizing the variance explained by each factor. Typically orthogonal (varimax) rotation results in the most readily interpretable factors of the various rotation methods. [100]

Aim 2: Determine Strongest Pattern Adherents

The second research aim was to identify individuals in the highest quintile for each response pattern and describe demographics for each subgroup. Factor scores were used to assign respondents into quintiles for each eating pattern. Dividing respondents into quintiles of factor scores has been used by other diet researchers as a way of determining who the strongest adherents are for a given pattern [68, 90, 100]. In an analysis of 2003-2006 NHANES data, Sofianou et al. [100] found the fifth (top) quintile of the Western pattern to be associated with higher total energy intake, as well as higher intakes of sugar, total fat, and saturated fat when compared to the first quintile. Although Slattery et al. report that

factor loadings of 0.2 determine which variables load to a factor (albeit at a low level), [109] other researchers use 0.4 as the cutoff for strong correlation to a pattern [89, 100]. The 0.4 cutoff was deemed most appropriate for this analysis in order to find the food items that most strongly characterize a given pattern. In bivariate analyses demographic variables will include age, race, gender, household income, marital status, and education level. [108] It should be noted that an individual could be classified as a strong adherent of both the healthy and unhealthy eating patterns if they consumed foods loading highly on each of these factors (top quintiles for each factor are not mutually exclusive).

Aim 3: Predict respondent pattern adherence based on dietary habit data from 24-hour recalls

FFQ respondents following the first two factors (diet patterns) in each grouping were identified and pattern data for individuals in each subgroup was merged with 24-hour dietary recall data. The unique respondent ID number (SEQN) is found in both the FFQ, dietary recall, demographics and other datasets and allows merging of data between all of these datasets.

Logistic models were constructed using dietary habit information from 24-hour recall data as predictors (major food groups represented, meal size (total energy), number of eating occasions, food source, breakfast skipping, and number of snacking occasions). Major food groups represented will be reported as a diet score, equivalent to the total number of food groups represented on day one of a particular respondent's diet record. Meal size is measured in terms of total energy

of all in terms reported on day one of the diet record. Meal occasions are self-reported; is coded as belonging to a particular meal, similar to the method employed by Kant et al [72]. Each food item is also given a time stamp. The total number of eating occasions were calculated based on the number of unique time stamps in a respondent's day 1 dietary recall responses. Food source information was coded using values in Table 33.

Table 3. Coding for "source of food" variable from the 2005-06 NHANES Individual Foods File (Question DR1FS, "Where did you get (this/most of the ingredients for this) FOODNAME?")

Code	Description	Code	Description
1	Store	13	Community program, no additional information
2	Restaurant with waiter/waitress	14	Vending machine
3	Restaurant fast food/pizza	15	Common coffee pot or snack tray
4	Bar/tavern/lounge	16	From someone else/gift
5	Restaurant, no additional information	17	Mail order purchase
6	Cafeteria not at school	18	Residential dining facility
7	Cafeteria at school	19	Grown or caught by you or someone you know
8	Child care center	20	Fish caught by you or someone you know
9	Family/adult day care center	24	Sport, recreation, or entertainment
10	Soup kitchen/shelter/food pantry facility	25	Street vendor, vending truck
11	Meals on Wheels	26	Fundraiser sales
12	Community food program – other	91	Other, specify

Per previously described methods, respondent-identified eating occasions included breakfast, brunch, lunch, dinner, and supper (or their equivalents in Spanish). Eating occasions identified by the respondent as breakfast, desayuno, or

almuerzo were considered breakfast, consistent with the definition used by the US Department of Agriculture. Eating occasions identified as snack, merienda, entre comida, botana, bocadillo, and tentempie were coded as a snack. [80, 110]

Two days of 24-hour dietary recall data are collected in NHANES. The first day of data is collected in person by an interviewer at a mobile examination center (MEC), and the second day of data is collected several days later by phone. Using data from both days may produce a more accurate picture of usual dietary intake than using data from one day [32, 111, 112], although there is no consensus as to how to best use both days of data. Willett [35] states that averaging data from more than one day can improve estimates of true intake, but simply averaging values from both days may be inferior to statistical modeling techniques such as the Multiple Source Method (MSM) and National Cancer Institute (NCI) method which use FFQ data as covariates. The NCI and MSM methods do not appear to improve prediction of usual food intake with regularly consumed foods, but may improve prediction with episodically consumed foods [113-115]. A model by Beaton et al [116] showed that data from several days is necessary to predict true intake depending on the specific nutrient being measured. This analysis is examining dietary habit data from 24-hour recalls and not nutrient data however, and similar studies have averaged both days of data[100], or found that 24-hour dietary recall data collected by phone is similar to data collected in person [117].

Derivation of Study Variables

Each food item in the 24-hour recall dataset included information on where the food was obtained (food source), what time it was consumed, what eating occasion the food item belonged to according to the respondent, total Calories for the food item based on a USDA database, a unique food code putting each food item into one of nine groups, and nutrient profile variables (see

Table 4). Total Calories per day were calculated based on the sum of Calorie values for every food item listed for a particular respondent for the recorded day of intake. The USDA food code for each items corresponded to nine major food groups (milk, meat, eggs, legumes, grains, fruit, vegetables, fats/oils, sweets). The diet score variable calculated for each responded was the total food groups represented on the day of dietary recall. The variable for total eating occasions was calculated based on the number of unique eating occasions on the day of dietary recall for a particular respondent based on the time stamp. Foods with the same time stamp were considered to belong to the same eating occasion. This is distinct from the respondent-defined meal variable (e.g. “breakfast”, “lunch” etc.) which was used in identifying the number of snacking occasions, and those individuals who skipped breakfast. The snack variable in this analysis consisted of the total number of snack items reported by the respondent on the day of dietary recall.

Table 4. Food and Participant Data Collected During the Two NHANES 24-Hour Recall Interviews (Individual Food File Data)

Information specific to each food and beverage consumed on a recall day:	• Detailed description (type, form, brand name) • Additions to the food • Amount consumed • What foods were eaten in combination • Time eating occasion began • Name of eating occasion • Food source • Whether food was eaten at home • Amounts of food energy
Information specific to the recall day:	• Day of the week (recall day) • Recall day's consumption amount compared to typical diet • Daily total intakes of food energy

RESULTS

Study Sample Demographics

The study sample consisted of 2807 adults aged 18 years or older with an FFQ 90% complete. The demographic makeup is shown in

Table 5. Analyses were restricted to those individuals with FFQs at least 90% complete to reduce the possibility of response bias. Variables with as much as 3% missing responses were found in the FFQ dataset. These were not considered to be problematic as Dietcalc software counts missing FFQ responses as zero (item not consumed). Women comprised 56% of the cohort. Respondents were mostly evenly spread throughout the age range, with the most respondents (55%) being between ages 25 and 54. Non-Hispanic whites were the largest ethnic subgroup (47%), while the "other Hispanic" and "other race/multiracial" groups were the smallest (3% and 5% respectively). Most respondents (55%) had either a high school degree, GED or some college education, and 21% of the sample were college graduates. About half of the sample were married (52%), with "never married" being the second most common marital status (24%). Another 20% were either divorced or living with a partner, and the remaining 6% were widowed or separated. Income distribution was bimodal with peaks at the $15,000-$34,999 group (27%) and $75,000 and above group (25%).

Table 5. Demographics by FFQ Complete

total n=2934	**Total**		**FFQ Half Complete** n=2923		**FFQ 2/3 Complete** n=2918		**FFQ 90% Complete** n=2807	
Gender	**Freq**	Percent	**Freq**	Percent	**Freq**	Percent	**Freq**	Percent
Male	**1294**	44.1	**1287**	44.03	**1285**	44.04	**1235**	44
Female	**1640**	55.9	**1636**	55.97	**1633**	55.96	**1572**	56
Age at Screening								
18-24	**578**	19.7	**577**	19.74	**577**	19.77	**567**	20.2
25-39	**843**	28.73	**839**	28.7	**837**	28.68	**813**	28.96
40-54	**811**	27.64	**811**	27.75	**811**	27.79	**781**	27.82
55-69	**702**	23.93	**696**	23.81	**693**	23.75	**646**	23.01
Race/Ethnicity								
Mexican American	**614**	20.93	**608**	20.8	**605**	20.73	**569**	20.27
Other Hispanic	**99**	3.37	**98**	3.35	**98**	3.36	**94**	3.35
Non-Hispanic White	**1369**	46.66	**1368**	46.8	**1367**	46.85	**1326**	47.24
Non-Hispanic Black	**710**	24.2	**707**	24.19	**706**	24.19	**680**	24.23
Other Race or Multiracial	**142**	4.84	**142**	4.86	**142**	4.87	**138**	4.92
Education Level								
Less Than 9th Grade	**219**	7.98	**216**	7.89	**213**	7.79	**187**	6.66
9th to 11th Grade	**506**	14.96	**501**	14.87	**500**	14.86	**476**	16.96
High School, GED	**731**	23.85	**731**	23.94	**731**	23.99	**707**	25.19
Some College or AA Degree	**869**	30.12	**867**	30.16	**866**	30.18	**841**	29.96
College Graduate or Above	**608**	23.09	**607**	23.14	**607**	23.19	**595**	21.2
Marital Status								
Married	**1528**	52.11	**1521**	52.07	**1517**	52.02	**1458**	51.98
Widowed	**87**	2.97	**86**	2.94	**86**	2.95	**75**	2.67
Divorced	**275**	9.38	**275**	9.41	**274**	9.4	**264**	9.41
Separated	**81**	2.76	**81**	2.77	**81**	2.78	**76**	2.71
Never married	**696**	23.74	**693**	23.72	**693**	23.77	**676**	24.1
Living with partner	**265**	9.04	**265**	9.07	**265**	9.09	**256**	9.13
Annual Household Income								
$0 to $14,999	**359**	12.79	**357**	12.76	**356**	0.13	**341**	12.68
$15,000 to $34,999	**770**	27.44	**768**	27.45	**765**	0.27	**727**	27.04
$35,000 to $54,999	**565**	20.14	**561**	20.05	**561**	0.2	**535**	19.9
$55,000 to $74,999	**408**	14.54	**408**	14.58	**408**	0.15	**401**	14.91
$75,000 and Over	**704**	25.09	**704**	25.16	**703**	0.25	**685**	25.47

Factor Analysis Output

Factor analyses were run with three different grouping schemes to test the effect of grouping on factor output. Because the results of the first (ungrouped) and second (39 categories) grouping schemes had similar results regarding major factors extracted, the 39 variable grouping was chosen to proceed with the next step of the analysis. By using categorized data, a measure of data granularity was preserved that allows sufficient diversity of dietary patterns to be uncovered, while simplifying the interpretation of results.

Scree plots were used to help determine the number of factors to retain for rotation; the “elbow” typically representing the optimal eigenvalue cutoff, after which factors account for less and less variability in the dataset. When analyzing the output of a principal component analysis, it is important to remember that the resulting components may or may not make intuitive sense until after rotation, at which point the major factors generally describe one of several recognizable eating patterns commonly found in epidemiologic studies. Any labels applied to these factors are chosen by the researcher.

In the ungrouped analysis, the varimax rotation resulted in 19 factors above eigenvalue 1.25. The first three factors are characterized as healthy, Western, and dessert. Factor loading cutoff was .40, based on previous research [100]. The healthy factor consisted almost exclusively of fruits and vegetables (listed in

Table 6). The Western pattern consisted of white bread, pasta, fried potatoes, beef products and processed meats, potato chips, and catsup (Table 7).

Table 6. Ungrouped Analysis: Foods Having 0.40 Score or Above for the Healthy Diet Pattern

Food Item	Factor Loading
Carrots__no_fat_added	.60
Broccoli__no_fat_added	.59
Peaches_nectarines_plums	.54
Strawberries	.51
Caulifl_Br_Spr__no_fat_added	.50
Cucumbers	.50
Grapes__all	.50
Squash	.50
Veg_med__no_fat_added	.50
Melons	.49
Oranges__tangelo_etc	.49
Apples	.48
Lettuce__dark_green	.48
Pears	.47
Raw_spinach_greens	.47
String_beans__no_fat_added	.47
Bananas	.45
Coleslaw	.44
Other_fruits	.44
Peas__no_fat_added	.44
Tomatoes__raw	.42
Cabbage_sauerkraut	.41
Ckd_spinach_greens__no_fat_added	.41

Table 7. Ungrouped Analysis: Foods Having 0.40 Score or Above for the Western Diet Pattern

Food Item	Factor Loading
Breads_rolls__white	.48
Macaroni_and_cheese	.48
Potatoes__fried	.48
Hot_dogs__regular	.47
Ham__cold_cut__lunch_meat__reg	.45
Pasta__meat_fish_sauce	.42
Cold_cuts__poultry	.41

Potato_othr_chips__not_corn___re	.41
Tomato_catsup	.41
Beef__burgers___reg	.40
Beef__gr__meatballs_loaf_mixture	.40

Factors resulting from the three grouping schemes are reported in Tables 8, 9, and 10. Factor loadings both before and after orthogonal rotation are presented to demonstrate the effect of rotation on resulting factors. Rotation generally resulted in the clustering of foods that appeared to belong to a recognizable eating pattern found previously in the literature. For the 216 variable (ungrouped) and 39 variable grouping schemes, the first factor (explaining the most variance in the dataset) was the healthy followed by the Western pattern. These results were expected given the results of similar studies [100]. In the 39 category analysis the varimax rotation resulted in 3 factors above eigenvalue 1.25. The top two factors were again characterized as healthy and Western based on the foods with the highest factor loadings, but the third factor was renamed "coffee, cream and sugar" based on that factor's contents. In the 23 category analysis, the varimax rotation resulted in 2 factors above eigenvalue 1.25 (the first two factors were also the only factors with eigenvalues above 1.0). The factors are characterized as Western and healthy.

Figure 3. Scree Plot for Ungrouped Factor Analysis Output

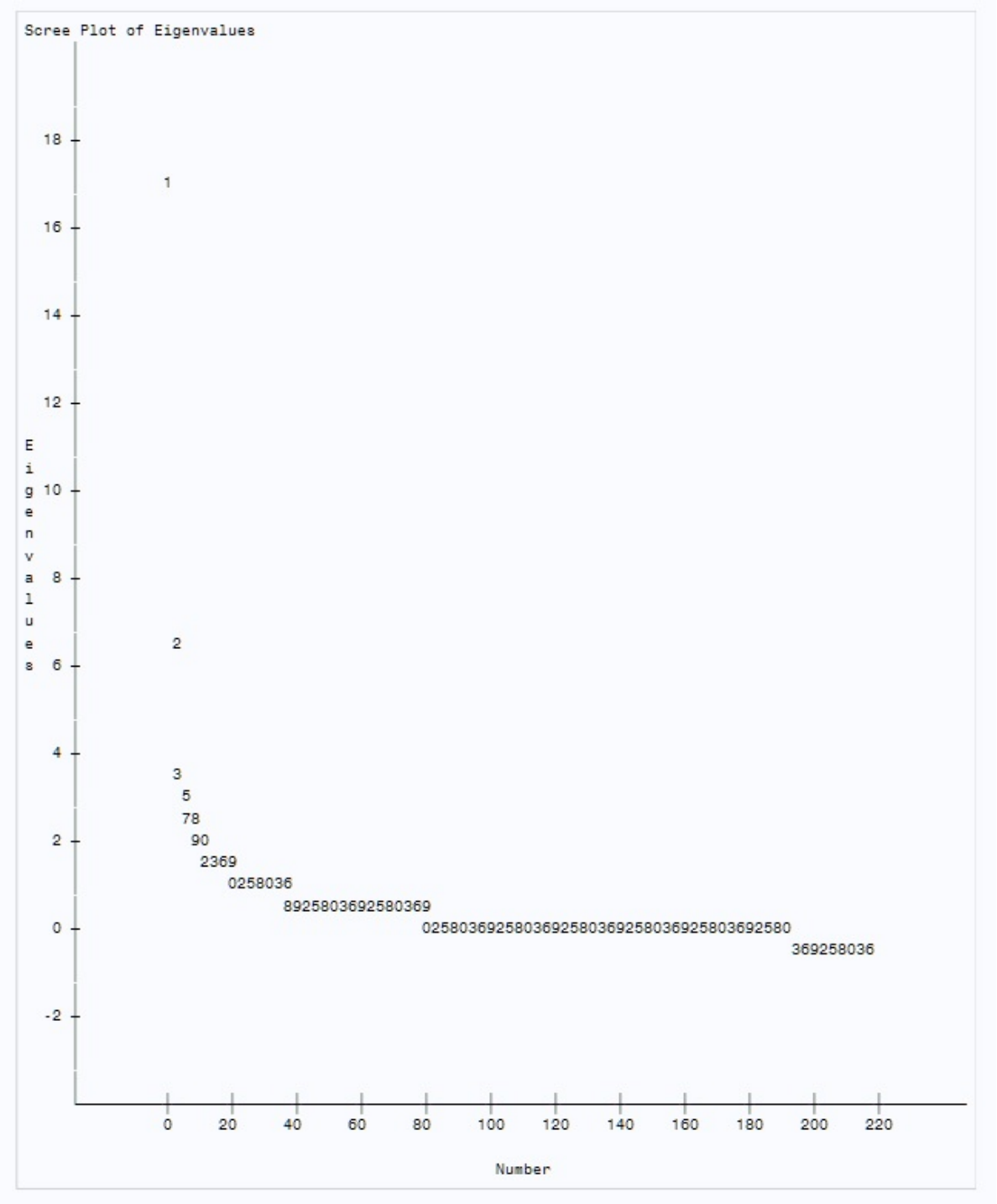


Table 8. Ungrouped Factor Pattern

(rotated factor loadings in **bold**)	Factor1: Healthy			Factor2: Western			Factor3: Dessert		
Alc_bev__liquor	4		**-8**	6		**8**	1		**-6**
Apple_juice	34		**20**	5		**17**	-22		**0**
Apples	38		**48**	* -30		**-2**	-15		**9**
Applesauce_ckd_apples	32		**28**	1		**11**	-5		**14**
Artificial_sweetener_in_coffee_t	5		**1**	-3		**-5**	19		**2**
Bacon__lean_Canadian	28		**5**	6		**2**	26		**4**
Bacon__regular	17		**2**	29		**32**	-15		**3**
Bananas	34		**45**	* -28		**-8**	-11		**11**
Beans	24		**19**	-17		**-2**	-32		**2**
Beef__burgers___reg	18		**-9**	40		**40** *	-11		**18**
Beef__burgers__lean	20		**-4**	26		**30**	3		**5**
Beef__gr__meatballs_loaf_mixture	32		**4**	27		**40** *	2		**5**
Beef__roast	45	*	**8**	22		**20**	18		**24**
Beef__steaks__lean	27		**9**	1		**9**	8		**-2**
Beef__steaks__reg	30		**14**	15		**30**	-19		**4**
Beef_stews_pot_pies_mixtures	47	*	**16**	15		**21**	4		**9**
Beer	3		**-9**	10		**10**	-1		**-5**
Biscuits__all	39		**21**	17		**29**	-8		**10**
Bread_not_white	22		**23**	-10		**10**	10		**3**
Breads_rolls__white	18		**-6**	42	*	**48** *	-6		**7**
Broccoli__no_fat_added	48	*	**59**	* -30		**7**	-3		**9**
Butter__reduced_fat_on_bread_pan	25		**12**	-4		**4**	24		**11**
Butter__reduced_fat_on_pot_veg_g	19		**6**	1		**6**	20		**2**
Butter__reg_on_bread_pan_waff	21		**3**	23		**21**	0		**19**
Butter__reg_on_pot_veg_grains	18		**4**	23		**22**	-6		**11**
Cabbage_sauerkraut	39		**41**	* -19		**8**	-19		**-9**
Cakes	44	*	**22**	16		**18**	16		**36**
Candy__chocolate	17		**-3**	22		**24**	14		**34**
Candy__not_chocolate	29		**2**	28		**27**	3		**41** *
Carrots__no_fat_added	44	*	**60**	* -38		**2**	-4		**3**
Caulifl_Br_Spr__no_fat_added	48	*	**50**	* -26		**-2**	-4		**15**
Cheese__lowfat	16		**12**	-18		**-5**	29		**8**
Cheese__reg	11		**-5**	27		**37**	-7		**11**
Chicken__dark_w_skin	9		**2**	9		**11**	-4		**0**
Chicken__dark_wo_skin	15		**10**	-7		**-1**	0		**-1**
Chicken__fr__dark_w_skin	10		**-4**	25		**21**	-7		**3**
Chicken__fr__light_w_skin	24		**-4**	31		**22**	2		**29**
Chicken__fr__light_wo_skin	18		**4**	5		**9**	-3		**9**
Chicken__light_w_skin	12		**8**	1		**8**	0		**1**
Chicken__light_wo_skin	12		**19**	-26		**-9**	13		**1**
Chicken__mixtures	31		**15**	-2		**10**	4		**16**
Chicken_fr__dark_wo_skin	15		**3**	4		**2**	-8		**3**
Chicken_turkey_ground	35		**18**	-2		**8**	0		**12**
Chili	28		**17**	-5		**4**	-16		**5**
Ckd_spinach_greens__no_fat_added	33		**41**	* -24		**4**	-14		**-11**
Coffee__decaf__no_cr_sug	6		**8**	-8		**-8**	14		**1**
Coffee__reg__no_cr_sug	2		**-2**	3		**-2**	14		**1**
Cold_cuts__lowfat	20		**2**	3		**7**	19		**-1**

Cold_cuts__poultry	35		**16**		14		**41**	*	5	**-3**	
Cold_cuts__regular	19		**-3**		32		**39**		-3	**1**	
Coleslaw	43	*	**44**	*	-15		**14**		-15	**-7**	
Cookies__brownies	29		**8**		18		**17**		23	**43**	*
Corn__no_fat_added	45	*	**32**		12		**39**		-14	**9**	
Corn_chips__lowfat	37		**17**		-4		**-1**		21	**32**	
Corn_chips__reg	16		**-1**		18		**20**		-4	**27**	
Cornbread_muffins	41	*	**22**		17		**26**		0	**24**	
Cot_ricot_cheese	30		**24**		-16		**-1**		9	**9**	
Crackers	31		**19**		3		**18**		16	**18**	
Cream__reg_or_1_2_1_2_in_coffee	8		**2**		2		**-3**		7	**1**	
Cream_cheese__lowfat	29		**13**		-8		**-4**		20	**23**	
Cream_cheese__reg	28		**13**		3		**7**		-1	**14**	
Crisps_cobblers	50	*	**15**		12		**3**		23	**42**	*
Cucumbers	42	*	**50**	*	-30		**6**		-12	**-5**	
Donuts__swt_rolls__danish__pop_t	34		**6**		24		**18**		14	**47**	*
Dried_fruit	25		**39**		-30		**-12**		4	**10**	
Eggs__regular	13		**6**		14		**24**		-12	**-1**	
Eggs__salad	24		**14**		10		**23**		-8	**-6**	
Eggs__substitutes	17		**15**		-7		**3**		6	**4**	
Eggs__whites_only	19		**21**		-11		**4**		-4	**0**	
Eng_muf_bagel	30		**16**		-2		**9**		15	**19**	
Fish__not_fried	35		**19**		-14		**-9**		10	**21**	
Fish__oysters	28		**2**		1		**3**		5	**4**	
Fish__smoked	33		**19**		-10		**0**		-4	**3**	
Fish_fried	47	*	**21**		5		**16**		-6	**11**	
Frozen_yogurt__ices__sorbet__etc	36		**31**		-14		**5**		-4	**15**	
Frt_drinks__diet	17		**9**		-6		**-2**		10	**0**	
Fruit_drinks__reg	18		**-1**		31		**33**		-22	**5**	
Granola_bars	21		**14**		-7		**1**		13	**13**	
Grape_juice	20		**11**		2		**10**		-11	**-6**	
Grapefruit	34		**40**		-24		**-1**		-9	**-3**	
Grapes__all	42	*	**50**	*	-19		**8**		-14	**12**	
Gravy	34		**11**		18		**26**		-8	**-1**	
Ham__cold_cut__lunch_meat__lowfa	22		**7**		2		**16**		18	**-6**	
Ham__cold_cut__lunch_meat__reg	25		**6**		26		**45**	*	-9	**1**	
Ham__not_luncheon	42	*	**2**		21		**12**		22	**33**	
Hot_brkfst_cereals___not_oatmeal	17		**13**		9		**12**		-11	**3**	
Hot_dogs__regular	30		**11**		32		**47**	*	-15	**5**	
Hot_dogs__turky_lowfat	34		**12**		6		**20**		10	**4**	
Ice_cream__reg	29		**6**		29		**31**		4	**34**	
Ice_cream_ice_milk__lowfat	26		**11**		-3		**-5**		25	**29**	
Jams__jelly__frt_butters	43	*	**25**		10		**26**		9	**15**	
Lasagna__rav__shells__etc	50	*	**23**		8		**30**		8	**6**	
Lettuce__dark_green	32		**48**	*	-41	*	**-3**		0	**-7**	
Lettuce__not_dark_green	18		**16**		-6		**13**		0	**-3**	
Liver__liverwurst	31		**3**		7		**7**		8	**-3**	
Macaroni_and_cheese	31		**4**		32		**48**	*	-9	**-2**	
Maple_syrup_on_pancakes__etc	33		**10**		25		**36**		-3	**24**	
Margarine__diet_on_pot_veg_grain	18		**9**		-6		**2**		28	**3**	
Margarine__low_fat_on_bread_pan_	20		**12**		-9		**-1**		34	**13**	
Margarine__reg_on_bread_pan_waff	13		**-4**		31		**30**		-7	**7**	
Margarine__reg_on_pot_veg_grains	13		**-2**		31		**27**		-10	**6**	

Mayonnaise__diet	22		**9**		-3	**8**		24	**1**	
Mayonnaise__reg	18		**-4**		32	**35**		-7	**4**	
Meal_repl__liquid	14		**3**		-1	**-2**		4	**8**	
Melons	38		**49**	*	-24	**-1**		-11	**10**	
Milk__1__in_cereal	-3		**3**		-10	**-4**		14	**0**	
Milk__1__in_coffee_or_tea	0		**1**		-5	**-3**		6	**-2**	
Milk__1__to_drink	-2		**1**		-6	**-3**		10	**1**	
Milk__2__in_cereal	11		**5**		9	**11**		-1	**0**	
Milk__2__in_coffee_or_tea	12		**4**		2	**-2**		12	**5**	
Milk__2__to_drink	11		**6**		5	**3**		-2	**6**	
Milk__evap_cond_in_coffee_or_tea	1		**0**		-1	**-2**		-2	**-2**	
Milk__nonfat_skim_in_cereal	3		**6**		-18	**-7**		26	**0**	
Milk__nonfat_skim_in_coffee_or_t	4		**6**		-9	**-4**		10	**1**	
Milk__nonfat_to_drink	6		**9**		-15	**-6**		15	**-1**	
Milk__other_in_cereal	8		**10**		-9	**-4**		0	**-1**	
Milk__other_in_coffee_tea	2		**1**		-3	**-4**		0	**-1**	
Milk__other_to_drink	4		**6**		-7	**-4**		1	**1**	
Milk__rice__in_cereal	0		**0**		-4	**-2**		-2	**0**	
Milk__rice__to_drink	0		**-1**		-2	**0**		-2	**1**	
Milk__rice_in_coffee_or_tea	0		**0**		-3	**-1**		-3	**-1**	
Milk__soy__in_cereal	4		**11**		-14	**-6**		0	**4**	
Milk__soy__to_drink	1		**9**		-11	**-6**		0	**2**	
Milk__soy_in_coffee_or_tea	-2		**2**		-6	**-5**		3	**2**	
Milk__unpasteurized_in_cereal	2		**-1**		2	**-1**		-3	**1**	
Milk__unpasteurized_in_coffee_te	1		**2**		-1	**-1**		-2	**-2**	
Milk__unpasteurized_not_in_coffe	2		**0**		0	**-1**		-5	**-2**	
Milk__whole_in_cereal	13		**6**		18	**27**		-33	**1**	
Milk__whole_in_coffee_or_tea	4		**-1**		6	**4**		-11	**-3**	
Milk__whole_to_drink	13		**9**		6	**13**		-25	**1**	
Muffins_dessert_breads	43	*	**17**		9	**4**		17	**48**	*
Non_dairy_crm__liquid__diet_in_c	2		**2**		-6	**-7**		12	**4**	
Non_dairy_crm__liquid__reg_in_co	3		**-2**		4	**1**		-1	**0**	
Non_dairy_crm__powdrd__diet_in_c	1		**1**		-3	**-4**		6	**-1**	
Non_dairy_crm__powdrd__reg_in_co	7		**0**		8	**3**		10	**1**	
Nuts_seeds__butters	36		**23**		4	**23**		11	**14**	
Nuts_seeds__whole	26		**29**		-20	**-5**		12	**18**	
Oatmeal	23		**32**		-21	**-7**		0	**7**	
Oils__canola	7		**2**		7	**9**		-1	**3**	
Oils__corn	10		**1**		5	**5**		-25	**4**	
Oils__olive	11		**20**		-20	**-5**		-4	**-1**	
Oils__other	7		**-1**		16	**17**		-8	**1**	
Onions__no_fat_added	32		**37**		-25	**3**		-26	**-8**	
Orange_grpfrt_jce__all	32		**22**		-3	**8**		-19	**6**	
Oranges__tangelo_etc	42	*	**49**	*	-23	**2**		-16	**12**	
Other_fruits	36		**44**	*	-28	**-4**		-6	**6**	
Other_juice	30		**18**		2	**12**		-19	**2**	
Other_vegetables__no_fat_added	33		**39**		-24	**4**		-3	**-8**	
Pancke__waff__Fr_tst	24		**24**		-5	**14**		-10	**-7**	
Pasta__fat_added	42	*	**10**		15	**35**		-1	**4**	
Pasta__meat_fish_sauce	40	*	**11**		22	**42**	*	5	**3**	
Pasta__meatless_red_sauce	35		**15**		-4	**13**		9	**14**	
Pasta__no_fat_added	15		**15**		-8	**0**		-10	**-1**	
Pasta_salad	48	*	**24**		6	**21**		5	**9**	

Peaches_nectarines_plums	45	*	**54**	*	-24		**4**		-12	**10**
Pears	40		**47**	*	-22		**-2**		-14	**8**
Peas__no_fat_added	42	*	**44**	*	-8		**25**		-7	**-7**
Peppers__no_fat_added	35		**35**		-23		**4**		-23	**-5**
Pickled_veg_frt	32		**19**		11		**35**		-4	**0**
Pies__crm_custrd_othr	33		**14**		10		**14**		4	**26**
Pies__fruit	41	*	**14**		13		**11**		24	**33**
Pineapple	46	*	**36**		-9		**3**		-1	**19**
Pizza__with_meat	25		**-6**		34		**33**		6	**36**
Pizza__without_meat	25		**10**		3		**8**		6	**14**
Popcorn	38		**13**		14		**17**		15	**37**
Pork	41	*	**12**		22		**27**		-7	**4**
Potato_othr_chips__not_corn___lo	27		**4**		4		**6**		23	**34**
Potato_othr_chips__not_corn___re	16		**-9**		41	*	**41**	*	-9	**23**
Potato_salads	48	*	**26**		7		**20**		-2	**17**
Potatoes__fried	28		**-3**		40		**48**	*	-16	**19**
Potatoes__white__no_fat_added	35		**9**		27		**38**		1	**17**
Pretzels	31		**22**		-5		**7**		14	**16**
Puddings_custards	46	*	**28**		0		**8**		13	**25**
Raw_spinach_greens	33		**47**	*	-38		**-4**		-6	**-8**
Rice_grains__white	13		**12**		-1		**11**		-25	**-8**
Rice_grains__whlgrn	30		**31**		-20		**4**		-12	**-9**
Roast_beef_in_sandwich	36		**6**		15		**24**		-6	**-1**
RTE_cereal___half_whole_grain	17		**23**		-19		**0**		8	**2**
RTE_cereal__half_whole_grain	9		**-2**		23		**29**		-16	**0**
Salad_drsg__all_on_salad_or_veg	31		**38**		-23		**9**		9	**3**
Sausage__reg	14		**-6**		33		**32**		-11	**4**
Sausage__turk_lowfat	34		**7**		7		**3**		26	**7**
Shortribs_spareribs	39		**14**		19		**30**		-5	**2**
Soft_drinks__diet__caff	3		**-4**		3		**4**		18	**7**
Soft_drinks__diet__decaf	5		**3**		-4		**0**		17	**-1**
Soft_drinks__reg__caff	2		**-17**		37		**30**		-19	**6**
Soft_drinks__reg__decaf	8		**-3**		17		**15**		-12	**3**
Soups__bean_type	37		**22**		-9		**2**		5	**8**
Soups__broth_w_ndles_rice	24		**12**		-4		**8**		-10	**4**
Soups__creamed	36		**9**		8		**13**		12	**13**
Soups__w_veggies	31		**17**		-3		**9**		-3	**3**
Sour_cream__lowfat	23		**8**		-6		**2**		18	**9**
Sour_cream__reg	20		**3**		12		**13**		-6	**15**
Squash	37		**50**	*	-33		**1**		-14	**-8**
Strawberries	48	*	**51**	*	-24		**3**		-8	**12**
String_beans__no_fat_added	42	*	**47**	*	-10		**25**		-12	**-3**
Stuffing_dumplings	50	*	**22**		14		**26**		3	**17**
Sugars_honey__all_in_coffee_or_t	7		**-3**		14		**7**		-4	**0**
Sugars_honey__not_in_coffee_tea	18		**8**		8		**9**		-3	**7**
Sushi__no_raw_fish	14		**4**		-6		**-4**		8	**3**
Sushi__raw_fish	25		**10**		-10		**1**		4	**2**
Sweet_potatoes__no_fat_added	43	*	**39**		-14		**6**		0	**11**
Tea__decaf__no_cr_sug	28		**21**		-10		**-1**		10	**8**
Tea__reg__no_cr_sug	8		**0**		11		**10**		2	**2**
Tofu__soy_meats	19		**16**		-17		**-7**		5	**6**
Tomato_catsup	25		**4**		28		**41**	*	-4	**9**
Tomato_salsa	24		**18**		-16		**-1**		-27	**6**

Tomato_veg_juice__all	16		**12**		-8	**-3**	-3	**2**
Tomatoes__raw	34		**42**	*	-34	**-1**	-20	**-8**
Tortillas_tacos__corn	11		**5**		-9	**-5**	-35	**6**
Tortillas_tacos__wheat	9		**2**		-2	**3**	-8	**2**
Tuna_canned	45	*	**29**		-1	**24**	7	**6**
Turkey	45	*	**19**		7	**21**	12	**17**
Veg_med__no_fat_added	48	*	**50**	*	-26	**7**	-13	**-4**
Wine	3		**-5**		-2	**0**	10	**-1**
Yogurt__all	27		**32**		-27	**-9**	4	**17**

Printed values are multiplied by 100 and rounded to the nearest integer.
Values greater than 0.4 are flagged by an *.

Figure 4. Scree Plot for 39 Category Factor Analysis Output

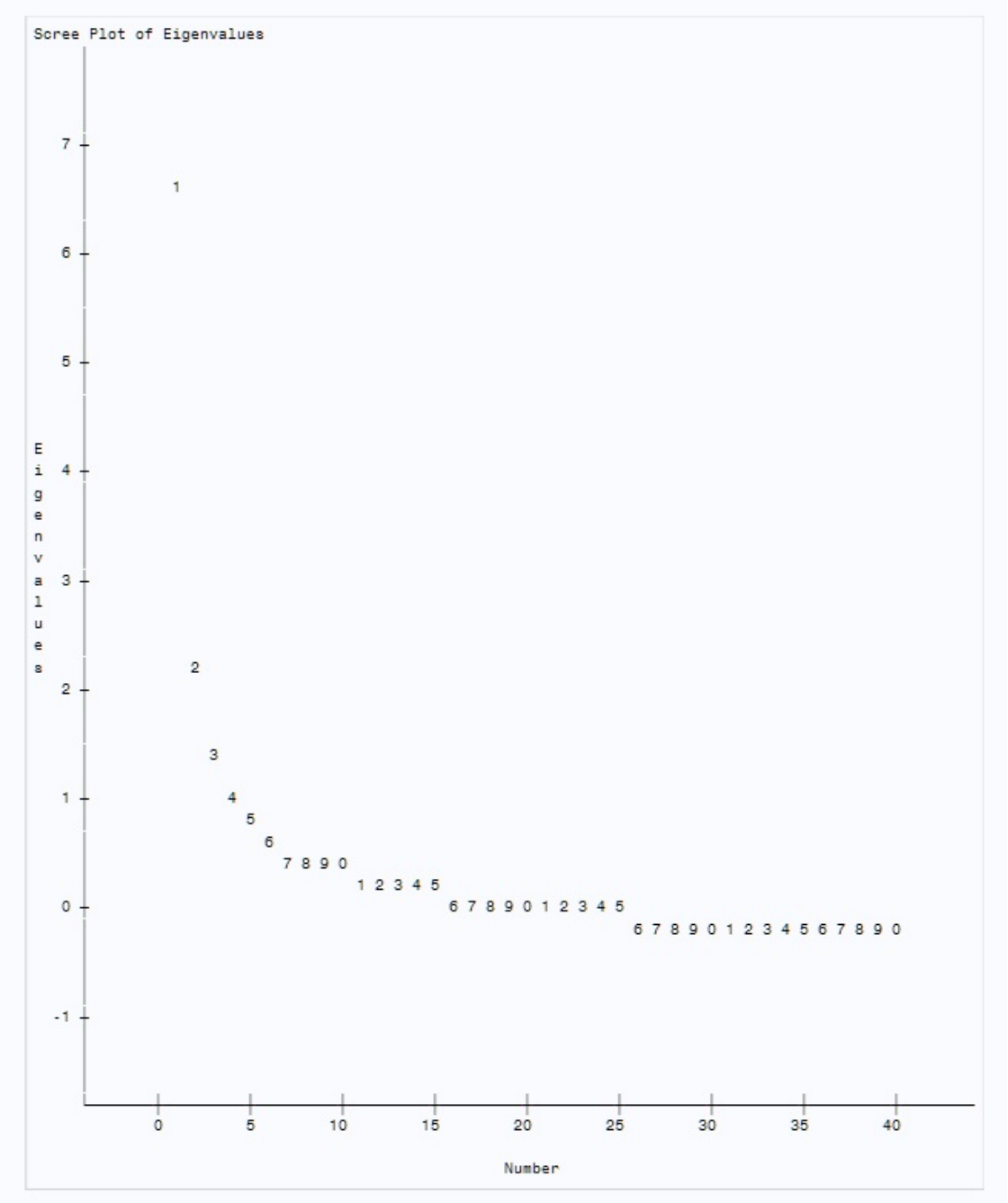

Scree Plot of Eigenvalues
Eigenvalues
Number
7
6
5
4
3
2
1
0
-1
0
5
10
15
20
25
30
35
40
1
2
3
4
5
6
7 8 9 0
1 2 3 4 5
6 7 8 9 0 1 2 3 4 5
6 7 8 9 0 1 2 3 4 5 6 7 8 9 0

Table 9. 39 Category Factor Pattern

	Unrotated		Rotated		Unrotated		Rotated		Unrotated		Rotated	
	Factor1: Healthy				Factor2: Western				Factor3: Coffee/Cream			
addedsugar	26		4		13		10		56	*	62	*
alcohol	6		-1		7		8		3		5	
beansleg	25		42	*	-32		-1		-18		-15	
breadwheat	24		25		-14		0		18		21	
breadwhite	39		1		38		52	*	-2		14	
buttmarg	25		-1		24		28		20		29	
candy	32		3		29		42	*	-2		11	
cereals	48	*	40	*	-8		28		-6		6	
coffee	8		-1		1		-10		55	*	55	*
dairyfull	39		17		11		25		29		40	*
dairylow	21		24		-13		3		3		7	
desserts	58	*	29		17		49	*	2		20	
driedfruit	23		39		-32		-9		5		6	
eggs	29		18		2		15		16		23	
fishfr	47	*	32		3		36		-11		2	
fishnot	52	*	44	*	-10		30		-11		2	
freshfruit	58	*	67	*	-36		15		-11		0	
juice	40	*	25		9		38		-20		-7	
nutseeds	41	*	38		-15		13		13		22	
oil	30		10		10		14		43	*	50	
pasta	61	*	34		15		53	*	-10		9	
pizza	32		3		31		48	*	-19		-5	
potatofr	41	*	-2		46	*	63	*	-15		3	
potatonot	48	*	21		19		43	*	4		20	
poultryfr	34		5		29		47	*	-14		0	
poultrynot	48	*	39		-4		33		-14		-1	
procmeat	57	*	23		25		57	*	-7		13	
redmeat	61	*	20		35		66	*	-8		14	
rice	29		36		-20		8		-10		-5	
saladdress	33		39		-25		-1		16		21	
saltysnack	53	*	30		11		42	*	2		18	
soups	41	*	34		-8		21		0		10	
sweetbev	14		-13		34		36		-9		0	
tea	26		14		2		11		25		31	
tomatoprod	47	*	52	*	-24		17		-11		-1	
tortilla	12		23		-16		4		-27		-25	
veggreen	64	*	73	*	-38		15		-2		10	
vegother	62	*	81	*	-54	*	0		7		16	
vegyellow	52	*	54	*	-25		15		4		14	

Printed values are multiplied by 100 and rounded to the nearest integer. Values greater than 0.4 are flagged with an asterisk.

Figure 5. Scree Plot for 23 Category Factor Analysis Output

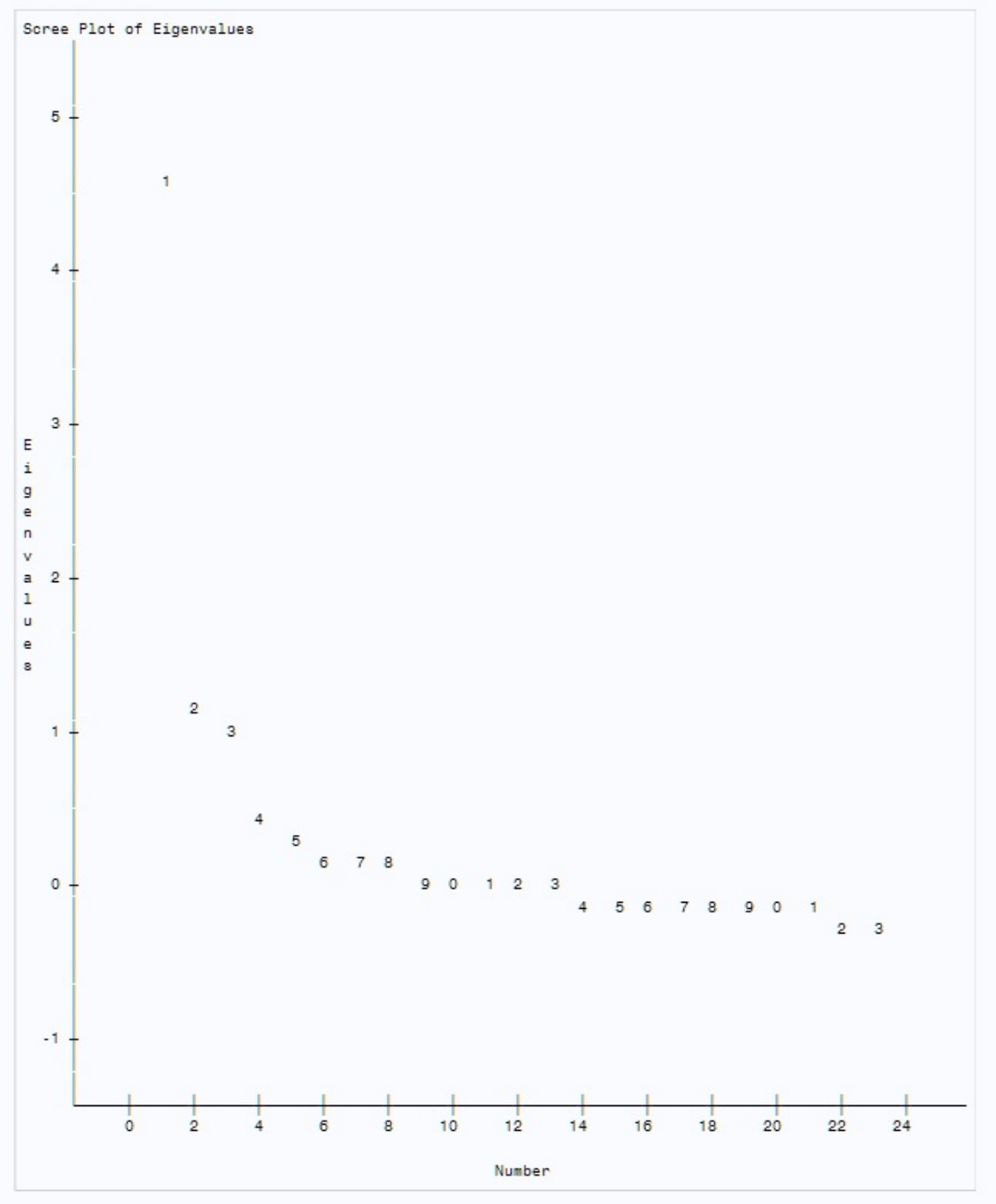


Table 10. 23 Category Factor Pattern

	Unrotated		Rotated		Unrotated		Rotated	
	Factor1: Western				Factor2: Healthy			
alcohol	7		9		6		1	
beansleg	26		-7		-36		44	*
beefpork	67	*	56	*	12		38	
breadetc	50	*	33		-4		38	
cereals	47	*	25		-12		42	*
chikfish	58	*	33		-12		50	*
cofftea	26		46	*	39		-10	
dairy	47	*	46	*	18		20	
eggs	30		25		5		18	
fatoil	45	*	52	*	29		10	
fruitjuice	55	*	23		-24		55	*
nutseeds	40		26		-3		30	
pasta	61	*	43	*	0		43	*
pizza	33		33		13		14	
potatoes	54	*	55	*	23		22	
rice	29		-1		-30		42	*
saltysnack	53	*	46	*	11		29	
soups	42	*	21		-12		38	
sweetbev	16		24		18		-2	
sweets	52	*	67	*	43	*	6	
tomatoprod	48	*	14		-28		54	*
vegetables	63	*	19		-36		70	*

Printed values are multiplied by 100 and rounded to the nearest integer. Values greater than 0.4 are flagged by an asterisk.

In the 216 variable (ungrouped) scheme, many food variables were not well represented in the cohort and did not contribute appreciably to any major factor. The 23 variable (smallest) scheme produced factors explaining a high degree of variability in the dataset, but the usefulness of the resulting factors was limited by having multiple foods grouped together in a single factor that might have otherwise appeared in separate healthy and unhealthy factors. For example, the 23 variable

grouping included both fried and unfried chicken in a single group, and also combined lean and processed meats in another group.

Demographics of Top Quintile for Each Major Pattern

Results of multivariate logistic models predicting the likelihood of a respondent following each of the major dietary patterns based on demographic subgroup are presented in Tables 11-15. Major factors were similar for the ungrouped and 39 category analyses, with the first factor being healthy and the second Western. The third pattern in the ungrouped analysis was “dessert” based on the food variables loading highly (candy and baked dessert items such as cookies, brownies, donuts, and Danishes). The third factor in the 39 category analysis was “coffee, cream and sugar” given the high factor loadings on coffee, sugar, full fat dairy, and oils.

Table 11. Demographics, Ungrouped Analysis

	Totals		Factor 1 "Healthy" Top Quintile				Factor 2 "Western" Top Quintile				Factor 3 "Dessert" Top Quintile			
total n=2807			n=561				n=561				n=561			
Gender	**Freq**	**%**	**Freq**	**%**	**OR**	**CI**	**Freq**	**%**	**OR**	**95% CI**	**Freq**	**%**	**OR**	**CI**
Male	**1235**	**44**	186	33.16	1.0 (ref)		303	54.01	1.0 (ref)		249	44.39	1.0 (ref)	
Female	**1572**	**56**	375	66.84	1.77**	1.46 to 2.15	258	45.99	0.60**	0.50 to 0.73	312	55.61	0.98	0.81 to 1.18
Age at Screening														
18-24	**567**	**20.2**	71	12.66	1.0 (ref)		176	31.37	1.0 (ref)		136	24.24	1.0 (ref)	
25-39	**813**	**28.96**	147	26.2	1.54**	1.14 to 2.09	173	30.84	0.60**	0.47 to 0.77	149	26.56	0.71**	0.55 to 0.92
40-54	**781**	**27.82**	172	30.66	1.97**	1.46 to 2.67	128	22.82	0.44**	0.34 to 0.57	151	26.92	0.76*	0.58 to 0.99
55-69	**646**	**23.01**	171	30.48	2.52**	1.86 to 3.41	84	14.97	0.33**	0.25 to 0.44	125	22.28	0.76*	0.58 to 1.00
Race/Ethnicity														
Mexican American	**569**	**20.27**	133	23.71	1.48**	1.16 to 1.88	69	12.3	0.59**	0.44 to 0.79	111	19.79	0.85	0.67 to 1.09
Other Hispanic	**94**	**3.35**	30	5.35	2.27**	1.44 to 3.58	19	3.39	1.09**	0.64 to 1.83	10	1.78	0.42**	0.21 to 0.82
Non-Hispanic White	**1326**	**47.24**	227	40.46	1.0 (ref)		251	44.74	1.0 (ref)		294	52.41	1.0 (ref)	
Non-Hispanic Black	**680**	**24.23**	128	22.82	1.12	0.88 to 1.43	205	36.54	1.85	1.49 to 2.29	131	23.35	0.84	0.67 to 1.06
Other Race or Multiracial	**138**	**4.92**	43	7.66	2.19**	1.49 to 3.23	17	3.03	0.6**	0.36 to 1.02	15	2.67	0.43**	0.25 to 0.74
Education Level														
Less Than 9th Grade	**187**	**6.66**	47	8.49	1.0 (ref)		26	4.77	1.0 (ref)		36	6.49	1.0 (ref)	
9th to 11th Grade	**476**	**16.96**	88	13.77	0.74	0.49 to 1.13	128	19.74	2.36**	1.43 to 3.91	87	12.34	0.92	0.57 to 1.49
High School, GED	**707**	**25.20**	113	19.81	0.63*	0.42 to 0.93	186	32.75	2.37**	1.47 to 3.85	142	23.43	1.09	0.70 to 1.68
Some College or AA Degree	**841**	**29.97**	165	30.19	0.79	0.54 to 1.15	163	30.37	1.6	0.99 to 2.59	155	28.45	1.03	0.67 to 1.58
College Graduate or Above	**595**	**21.20**	147	27.74	0.98	0.66 to 1.44	57	12.36	0.76	0.45 to 1.28	140	29.29	1.47	0.96 to 2.26
Marital Status														
Married	**1458**	**51.98**	327	58.39	1.0 (ref)		240	42.78	1.0 (ref)		286	50.98	1.0 (ref)	
Widowed	**75**	**2.67**	22	3.93	1.44	0.86 to 2.40	12	2.14	0.97	0.51 to 1.82	15	2.67	1.02	0.57 to 1.83
Divorced	**264**	**9.41**	56	10	0.93	0.68 to 1.28	43	7.66	0.99	0.69 to 1.41	37	6.6	0.67*	0.46 to 0.97
Separated	**76**	**2.71**	19	3.39	1.15	0.67 to 1.97	19	3.39	1.69	0.99 to 2.90	20	3.57	1.46	0.86 to 2.48
Never married	**676**	**24.1**	98	17.5	0.59**	0.46 to 0.75	186	33.16	1.93**	1.55 to 2.40	154	27.45	1.21	0.97 to 1.51
Living with partner	**256**	**9.13**	38	6.79	0.60**	0.42 to 0.87	61	10.87	1.59**	1.15 to 2.18	49	8.73	0.97	0.69 to 1.36
Annual Household														
$0 to $14,999	**341**	**12.68**	74	13.99	1.0 (ref)		103	19.14	1.0 (ref)		70	13.11	1.0 (ref)	
$15,000 to $34,999	**727**	**27.04**	142	26.84	0.88	0.64 to 1.20	158	29.37	0.64**	0.48 to 0.86	124	23.22	0.8	0.58 to 1.10
$35,000 to $54,999	**535**	**19.9**	112	21.17	0.96	0.69 to 1.33	119	22.12	0.66**	0.49 to 0.90	99	18.54	0.88	0.63 to 1.24
$55,000 to $74,999	**401**	**14.91**	62	11.72	0.66	0.45 to .096	72	13.38	0.51**	0.36 to 0.71	88	16.48	1.09	0.76 to 1.55
$75,000 and Over	**685**	**25.47**	139	26.28	0.92	0.67 to 1.26	86	15.99	0.33**	0.24 to 0.46	153	28.65	1.11	0.81 to 1.53

*p<0.05, **p<0.01

Table 12. Demographics, 39 Category Output

	Totals		Factor 1 "Healthy" Top Quintile n=561					Factor 2 "Western" Top Quintile n=561					Factor 3 "Coffee, Cream+Sugar" Top n=561				
total n=2807																	
Gender	**Freq**	**%**	**Freq**	**%**	**OR**	**95%CI**		**Freq**	**%**	**OR**	**95%CI**		**Freq**	**%**	**OR**	**95%CI**	
Male	**1235**	**44**	208	37.08	ref			304	54.19	ref			271	48.31	ref		
Female	**1572**	**56**	353	62.92	1.43**	1.18	1.73	257	45.81	0.60**	0.5	0.72	290	51.69	0.80*	0.67	0.97
Age at Screening																	
18-24	**567**	**20.2**	71	12.66	ref			193	34.4	ref			37	6.6	ref		
25-39	**813**	**28.96**	152	27.09	1.61**	1.18	2.18	177	31.55	0.54**	0.42	0.69	113	20.14	2.31**	1.57	3.41
40-54	**781**	**27.82**	174	31.02	2.00**	1.48	2.7	116	20.68	0.34**	0.26	0.44	210	37.43	5.27**	3.64	7.62
55-69	**646**	**23.01**	164	29.23	2.38**	1.75	3.23	75	13.37	0.26**	0.19	0.34	201	35.83	6.47**	4.46	9.39
Race/Ethnicity																	
Mexican American	**569**	**20.27**	176	31.37	2.31**	1.84	2.91	85	15.15	0.85	0.65	1.12	57	10.16	0.29**	0.21	0.39
Other Hispanic	**94**	**3.35**	32	5.7	2.67**	1.7	4.19	20	3.57	1.31	0.78	2.19	13	2.32	0.42**	0.23	0.75
Non-Hispanic White	**1326**	**47.24**	215	38.32	ref			227	40.46	ref			370	65.95	ref		
Non-Hispanic Black	**680**	**24.23**	97	17.29	0.86	0.66	1.12	209	37.25	2.15**	1.73	2.67	94	16.76	0.41**	0.32	0.53
Other Race or Multiracial	**138**	**4.92**	41	7.31	2.18**	1.47	3.24	20	3.57	0.82	0.5	1.35	27	4.81	0.63*	0.41	0.97
Education Level																	
Less Than 9th Grade	**187**	**6.66**	62	11.34	ref			37	7.35	ref			25	4.44	ref		
9th to 11th Grade	**476**	**16.96**	82	12.67	0.44**	0.3	0.67	128	19.82	1.42	0.91	2.22	87	13.89	1.67*	1.01	2.74
High School, GED	**707**	**25.20**	104	18.53	0.38**	0.26	0.56	177	30.07	1.27	0.83	1.94	140	25.37	1.89**	1.18	3.03
Some College or AA	**841**	**29.97**	165	29.68	0.51**	0.36	0.73	154	28.51	0.89	0.58	1.36	186	33.7	2.01**	1.27	3.19
College Graduate or Above	**595**	**21.20**	147	27.79	0.65*	0.45	0.94	64	14.25	0.53**	0.34	0.84	122	22.59	1.67*	1.04	2.68
Marital Status																	
Married	**1458**	**51.98**	343	61.25	ref			227	40.46	ref			320	57.14	ref		
Widowed	**75**	**2.67**	18	3.21	1.03	0.6	1.77	13	2.32	1.14	0.62	2.1	23	4.11	1.57	0.95	2.61
Divorced	**264**	**9.41**	48	8.57	0.72	0.52	1.01	39	6.95	0.94	0.65	1.36	76	13.57	1.44*	1.07	1.93
Separated	**76**	**2.71**	17	3.04	0.94	0.54	1.63	15	2.67	1.33	0.75	2.39	22	3.93	1.45	0.87	2.42
Never married	**676**	**24.1**	92	16.43	0.51**	0.4	0.66	204	36.36	2.34**	1.89	2.91	74	13.21	0.44**	0.33	0.57
Living with partner	**256**	**9.13**	42	7.5	0.64*	0.45	0.91	63	11.23	1.77**	1.29	2.43	45	8.04	0.76	0.54	1.07
Annual Household Income																	
$0 to $14,999	**341**	**12.68**	72	0.14	ref			99	18.54	ref			66	0.12	ref		
$15,000 to $34,999	**727**	**27.04**	159	0.3	1.05	0.76	1.43	155	29.03	0.66**	0.49	0.89	138	0.26	0.98	0.7	1.35
$35,000 to $54,999	**535**	**19.9**	101	0.19	0.87	0.62	1.22	109	20.41	0.63**	0.46	0.86	97	0.18	0.92	0.65	1.31
$55,000 to $74,999	**401**	**14.91**	59	0.11	0.65*	0.44	0.94	75	14.04	0.56**	0.4	0.79	87	0.16	1.15	0.81	1.65
$75,000 and Over	**685**	**25.47**	139	0.26	0.95	0.69	1.31	96	17.98	0.40**	0.29	0.55	149	0.28	1.16	0.84	1.6

*p<0.05
**p<0.01

Table 13. Demographics, 23 Category Output

	Totals		Factor 1 "Western" Top Quintile					Factor 2 "Healthy" Top Quintile				
total n=2807			n=561					n=561				
Gender	**Freq**	**%**	**Freq**	**%**	**OR**	**95% CI**		**Freq**	**%**	**OR**	**95% CI**	
Male	**1235**	**44**	289	51.52	ref			225	40.11	ref		
Female	**1572**	**56**	272	48.48	0.69**	0.57	0.83	336	59.89	1.22*	1.01	1.47
Age at Screening												
18-24	**567**	**20.2**	108	19.25	ref			134	23.89	ref		
25-39	**813**	**28.96**	139	24.78	0.88	0.66	1.16	177	31.55	0.9	0.7	1.16
40-54	**781**	**27.82**	167	29.77	1.16	0.88	1.52	137	24.42	0.69**	0.53	0.9
55-69	**646**	**23.01**	147	26.2	1.25	0.95	1.66	113	20.14	0.69**	0.52	0.91
Race/Ethnicity												
Mexican American	**569**	**20.27**	76	13.55	0.51**	0.39	0.67	201	35.83	4.28**	3.36	5.45
Other Hispanic	**94**	**3.35**	16	2.85	0.68	0.39	1.18	38	6.77	5.32**	3.41	8.31
Non-Hispanic White	**1326**	**47.24**	307	54.72	ref			150	26.74	ref		
Non-Hispanic Black	**680**	**24.23**	139	24.78	0.85	0.68	1.07	130	23.17	1.85**	1.44	2.39
Other Race or Multiracial	**138**	**4.92**	23	4.1	0.66	0.42	1.06	42	7.49	3.43**	2.3	5.12
Education Level												
Less Than 9th Grade	**187**	**6.66**	32	5.99	ref			71	13.91	ref		
9th to 11th Grade	**476**	**16.96**	105	16.57	1.46	0.92	2.31	113	16.56	0.46**	0.31	0.69
High School, GED	**707**	**25.20**	160	28.14	1.51	0.98	2.33	108	18.2	0.28**	0.19	0.41
Some College or AA Degree	**841**	**29.97**	177	32.14	1.32	0.86	2.03	170	31.29	0.41**	0.29	0.58
College Graduate or Above	**595**	**21.20**	86	17.17	0.84	0.53	1.32	98	20.04	0.32**	0.22	0.47
Marital Status												
Married	**1458**	**51.98**	284	50.62	ref			295	52.68	ref		
Widowed	**75**	**2.67**	17	3.03	1.21	0.7	2.11	13	2.32	0.83	0.45	1.52
Divorced	**264**	**9.41**	55	9.8	1.09	0.79	1.5	39	6.96	0.68*	0.48	0.98
Separated	**76**	**2.71**	20	3.57	1.48	0.87	2.5	20	3.57	1.41	0.83	2.38
Never married	**676**	**24.1**	133	23.71	1.01	0.81	1.27	140	25	1.03	0.82	1.29
Living with partner	**256**	**9.13**	52	9.27	1.05	0.76	1.47	53	9.46	1.03	0.74	1.43
Annual Household Income												
$0 to $14,999	**341**	**12.68**	84	15.64	ref			93	17.55	ref		
$15,000 to $34,999	**727**	**27.04**	149	27.75	0.79	0.58	1.07	191	36.04	0.95	0.71	1.27
$35,000 to $54,999	**535**	**19.9**	103	19.18	0.73	0.53	1.01	96	18.11	0.58**	0.42	0.81
$55,000 to $74,999	**401**	**14.91**	84	15.64	0.81	0.58	1.14	55	10.38	0.42**	0.29	0.61
$75,000 and Over	**685**	**25.47**	117	21.79	0.63**	0.46	0.87	95	17.92	0.43**	0.31	0.59

*p<0.05 , **p<0.01

Table 14. 39 Category Adjusted Output

	Totals		Factor 1 "Healthy" Top Quintile					Factor 2 "Western" Top Quintile					Factor 3 "Coffee, Cream+Sugar" Top Quintile				
	total n=2807		n=561					n=561					n=561				
Gender	**Freq**	**%**	**Freq**	**%**	**AOR**		**95% CI**	**Freq**	**%**	**AOR**		**95% CI**	**Freq**	**%**	**AOR**		**95% CI**
Male	1235	44.00	208	37.08	ref			304	54.19	ref			271	48.31	ref		
Female	1572	56.00	353	62.92	1.49**	1.21	1.82	257	45.81	0.54**	0.44	0.65	290	51.69	0.91	0.75	1.11
Age at Screening																	
18-24	567	20.20	71	12.66	ref			193	34.40	ref			37	6.60	ref		
25-39	813	28.96	152	27.09	1.41	0.99	2.01	177	31.55	0.65**	0.48	0.86	113	20.14	2.36**	1.54	3.63
40-54	781	27.82	174	31.02	2.15**	1.49	3.11	116	20.68	0.36**	0.26	0.49	210	37.43	4.78**	3.14	7.35
55-69	646	23.01	164	29.23	2.64**	1.80	3.87	75	13.37	0.24**	0.16	0.35	201	35.83	5.99**	3.86	9.31
Race/Ethnicity																	
Mexican American	569	20.27	176	31.37	3.07**	2.33	4.05	85	15.15	0.52**	0.38	0.71	57	10.16	0.32**	0.23	0.45
Other Hispanic	94	3.35	32	5.70	3.29**	2.02	5.37	20	3.57	0.84	0.48	1.47	13	2.32	0.49*	0.26	0.92
Non-Hispanic White	1326	47.24	215	38.32	ref			227	40.46	ref			370	65.95	ref		
Non-Hispanic Black	680	24.23	97	17.29	1.05	0.79	1.39	209	37.25	1.68**	1.32	2.13	94	16.76	0.39**	0.30	0.51
Other Race or Multiracial	138	4.92	41	7.31	2.37**	1.57	3.57	20	3.57	0.78	0.47	1.31	27	4.81	0.72	0.46	1.14
Education Level																	
Less Than 9th Grade	187	6.66	47	8.49	ref			37	7.35	ref			25	4.44	ref		
9th to 11th Grade	476	16.96	88	13.77	0.77	0.51	1.17	128	19.82	0.83	0.53	1.31	87	13.89	1.55	0.92	2.62
High School, GED	707	25.20	113	19.81	0.73	0.49	1.11	177	30.07	0.82	0.53	1.29	140	25.37	1.16	0.70	1.94
Some College or AA Degree	841	29.97	165	30.19	1.13	0.76	1.70	154	28.51	0.54**	0.34	0.86	186	33.70	1.39	0.84	2.32
College Graduate or Above	595	21.20	147	27.74	1.59*	1.02	2.48	64	14.25	0.39**	0.23	0.65	122	22.59	0.90	0.52	1.54
Marital Status																	
Married	1458	51.98	343	61.25	ref			227	40.46	ref			320	57.14	ref		
Widowed	75	2.67	18	3.21	0.72	0.40	1.30	13	2.32	1.70	0.87	3.31	23	4.11	1.15	0.66	2.01
Divorced	264	9.41	48	8.57	0.61**	0.42	0.87	39	6.95	0.96	0.65	1.42	76	13.57	1.20	0.87	1.65
Separated	76	2.71	17	3.04	0.78	0.43	1.44	15	2.67	0.89	0.47	1.71	22	3.93	1.70	0.97	2.97
Never married	676	24.10	92	16.43	0.70*	0.51	0.96	204	36.36	1.11	0.83	1.47	74	13.21	0.94	0.68	1.31
Living with partner	256	9.13	42	7.50	0.78	0.53	1.14	63	11.23	1.02	0.72	1.45	45	8.04	1.10	0.76	1.61
Annual Household Income																	
$0 to $14,999	341	12.68	72	0.14	ref			99	18.54	ref			66	0.12	ref		
$15,000 to $34,999	727	27.04	159	0.30	0.79	0.56	1.11	155	29.03	0.85	0.62	1.17	138	0.26	0.96	0.67	1.37
$35,000 to $54,999	535	19.90	101	0.19	0.71	0.49	1.03	109	20.41	0.78	0.55	1.10	97	0.18	0.78	0.54	1.15
$55,000 to $74,999	401	14.91	59	0.11	0.49**	0.32	0.74	75	14.04	0.77	0.53	1.12	87	0.16	0.95	0.64	1.41
$75,000 and Over	685	25.47	139	0.26	0.64*	0.44	0.94	96	17.98	0.66*	0.46	0.95	149	0.28	0.89	0.61	1.31

Table 15. 39 Category Output, Top Factors, Final Demographics Models

39 Variable Grouping,
Top Factors, Final Models

	Totals		Factor 1 (Healthy) Final Model						Weighted Final Model			Factor 2 (Western) Final Model						Weighted Final Model		
total n=2807																				
Gender	**Freq**	**%**		**Freq**	**%**	**AOR**	**95%CI**		**AOR**	**95%CI**			**Freq**	**%**	**AOR**	**95%CI**		**AOR**	**95%CI**	
Male	**1235**	**44**		208	37.1	ref			ref				304		ref					
Female	**1572**	**56**		353	62.9	1.50**	1.23	1.83	1.52**	1.27	1.82		257		0.54**	0.44	0.66	0.38**	0.28	0.50
Age at Screening				561	1.02	1.02**	1.03	1.03	1.03**	1.02	1.04		561†		0.97**	0.96	0.97	0.97**	0.96	0.98
18-24	**567**	**20**				(10 year increments)									(10 year increments)					
25-39	**813**	**29**																		
40-54	**781**	**28**																		
55-69	**646**	**23**																		
Race/Ethnicity																				
Mexican American	**569**	**20**	Mexican American	208	37.1	3.30**	2.61	4.17	4.29**	3.26	5.64	Mexican American	85		0.54**	0.41	0.72	0.51**	0.31	0.84
Other Hispanic	**94**	**3**	Other Hispanic									Non-Hispanic Black	20		1.81**	1.45	2.26	1.83**	1.33	2.53
Non-Hispanic White	**1326**	**47**	Non-Hispanic White	312	55.6	ref						Other Hispanic	227							
Non-Hispanic Black	**680**	**24**	Non-Hispanic Black									Non-Hispanic White	209		ref					
Other Race or Multiracial	**138**	**5**	Other Race or Multiracial	41	7.3	2.41**	1.62	3.59	2.24**	1.38	3.63	Other Race or Multiracial	20							
Education Level																				
Less Than 9th Grade	**187**	**7**		560	100.0	1.21**	1.10	1.33	1.36**	1.26	1.47	Less Than 9th Grade	560							
9th to 11th Grade	**476**	**15**										9th to 11th Grade			ref					
High School, GED	**707**	**24**										High School, GED								
Some College or AA	**841**	**31**													0.62**	0.50	0.78	0.64**	0.51	0.81
College Graduate or	**595**	**24**													0.43**	0.32	0.59	0.42**	0.30	0.58
Marital Status																				
Married	**1458**	**52**	Married	343	61.3	ref														
Widowed	**75**	**3**	Divorced	48	8.6	0.61**	0.43	0.87	0.52**	0.36	0.75									
Divorced	**264**	**9**	Widowed																	
Separated	**76**	**3**	Separated	169	30.2	0.75**	0.60	0.94	0.77	0.55	1.08									
Never married	**676**	**24**	Never married																	
Living with partner	**256**	**9**	Living with partner																	
Annual Household																				
$0 to $14,999	**341**	**13**	$0 to $14,999									$0 to $14,999								
$15,000 to $34,999	**727**	**27**	$15,000 to $34,999	332	0.63	ref						$15,000 to $34,999	438	82.0	ref					
$35,000 to $54,999	**535**	**20**	$35,000 to $54,999									$35,000 to $54,999								
$55,000 to $74,999	**401**	**15**		59	0.11	0.61**	0.44	0.83	0.58*	0.38	0.87	$55,000 to $74,999								
$75,000 and Over	**685**	**25**		139	0.26	0.85	0.66	1.10	0.91	0.71	1.16		96	18	0.78‡	0.60	1.02	0.77	0.55	1.09

*p<0.05, **p<0.01, ‡p=0.06

Effect of Variable Grouping in Unadjusted Models

Changes in variable categorization from ungrouped to 39 categories maintained most associations between demographic subgroups and major factor patterns. In the ungrouped analysis, women were 1.77 times more likely than men to follow the healthy diet pattern. This finding was attenuated (OR 1.43) in the 39 category variable grouping ($p<0.01$ for both values). Men were about half as likely (OR 0.6, $p<0.01$) to follow the Western pattern as women in the ungrouped analysis, and this finding did not change in the 39 category analysis. The age gradient seen in the ungrouped analysis with progressively older groups showing increased likelihood of following the healthy pattern was preserved in the 39 category analysis; the oldest age group being approximately two and a half times as likely to follow the healthy pattern as the youngest group (OR 2.52 for ungrouped, OR 2.38 for 39 category analysis, $p<0.01$). A decreasing age gradient was seen with adherence to the Western pattern, with respondents in the highest age group being about one third as likely as the youngest group to follow the Western pattern in either the ungrouped or 39 category analysis.

In the ungrouped analysis Mexican Americans and other Hispanics were both more likely to follow the healthy dietary pattern (OR 1.48, 2.27 respectively) than non-Hispanic whites, as were respondents in the other race/multiracial group (OR 2.19). These associations were similar in the 39 category analysis (2.31, 2.67, 2.18, $p<0.05$). Mexican Americans and other race/multiracial were about half as likely as non-Hispanic whites to follow the Western pattern in the ungrouped

analysis, but this association disappeared in the 39 category analysis for both subgroups.

Those with a high school or GED education were 0.63 times as likely to follow the healthy diet pattern ($p<0.05$) than those in the lowest education subgroup (less than 9th grade) in the ungrouped analysis. Collapsing variables into 39 categories resulted in significant findings across all education strata; those with a high school or GED education were less than half as likely to follow the healthy dietary pattern 0.44, 0.38) as those in the lowest subgroup, and those in the upper two strata (some college or associate's degree, college graduate or above) just over half as likely to follow the healthy dietary pattern (0.51, 0.65) as those in the lowest subgroup. Those with a high school education or GED were about 2.4 times more likely than the lowest education subgroup to adhere to the Western diet ($p<0.01$) in the ungrouped analysis. These associations disappeared in the 39 category analysis, where the only significant education subgroup finding was in the highest category, where those with a college education or above were about half as likely to follow the Western diet pattern (AOR 0.53, $p<0.01$).

Respondents who were either never married or living with a partner were about half as likely as married individuals to follow the healthy dietary pattern in the ungrouped analysis (OR 0.59, 0.60 respectively, $p<0.01$). There were similar findings in the 39 category analysis (OR 0.51, $p<0.01$; OR 0.64, $p<0.05$). The never married group were 1.93 times as likely as married individuals to follow the Western pattern and those living with a partner were 1.59 times as likely to follow

the Western pattern (both p values <0.01) in the ungrouped analysis. These associations were stronger in the 39 variable grouping (OR 2.34 and OR 1.77, respectively).

No significant findings were seen in the ungrouped analysis with regard to income and the healthy diet pattern, but the 39 category analysis showed those in the second highest income stratum ($55,000 to $74,999) to be about two thirds as likely to follow the healthy dietary pattern (OR 0.65, p<0.05) as those in the lowest income category. In the ungrouped analysis there was a generally downward trend with increasing income for following the Western pattern, with the second lowest income stratum ($15,000 to $34,999) being 0.66 times as likely as the reference group to follow the Western pattern, and the highest income stratum being 0.40 times as likely to follow it. Results for this subgroup were similar in the 39 category analysis.

Collapsing variables into 23 categories reversed some associations and strengthened others. In the 23 variable grouping the healthy dietary pattern was now the second factor (explaining the second largest amount of variance in the dataset), and women were more likely than men to follow this pattern (OR 1.22, p<0.05) but the association was not as strong as the other analyses. Interestingly, the age association was reversed, with the two highest age strata being less likely to follow the healthy diet pattern (OR 0.69 for both, p<0.01) when compared to the youngest age group. The association seen with Mexican Americans and other Hispanics was much stronger in this grouping (OR 4.28, 5.32, p<0.01), and this

was the only grouping to show black Americans with a significant likelihood of following the healthy diet pattern (OR 1.85, $p<0.01$) with non-Hispanic whites as the reference group. The association between other race/multiracial became stronger in this variable grouping as well (OR 3.43, $p<0.01$).

39 Category Output, Adjusted and Final Models

All demographic variables were included in a model to determine adjusted odds ratios. **Error! Not a valid bookmark self-reference.** and Table 17 show the healthy and Western patterns before and after adjustment, as well as a final model containing only significant variables and collapsing categories where appropriate. Gender effects were preserved after adjustment, as was the roughly linear relationship between age and likelihood of following either the healthy or Western patterns. For this reason the age variable was included as a continuous variable (in 10 year increments) in the final model.

Table 16. 39 Category Output Demographics Models, Healthy Pattern Only

	Totals		Unadjusted				Adjusted				Final Model					Weighted Final Model		
total n=2807							n=2783‡											
Gender	**Freq**	**%**	**Freq**	**%**	**OR**	**95%CI**		**AOR**	**95%CI**			**Freq**	**%**	**AOR**	**95%CI**		**AOR**	**95%CI**	
Male	**1235**	**44**	208	37.08	ref			ref				208	37.1	ref			ref		
Female	**1572**	**56**	353	62.92	1.43**	1.18	1.73	1.49**	1.21	1.82		353	62.9	1.50**	1.23	1.83	1.52**	1.27	1.82
Age at Screening												561	1.02	1.02**	1.03	1.03	1.03**	1.02	1.04
18-24	**567**	**20**	71	12.66	ref			ref						(10 year increments)					
25-39	**813**	**29**	152	27.09	1.61**	1.18	2.18	1.41	0.99	2.01									
40-54	**781**	**28**	174	31.02	2.00**	1.48	2.70	2.15**	1.49	3.11									
55-69	**646**	**23**	164	29.23	2.38**	1.75	3.23	2.64**	1.80	3.87									
Race/Ethnicity																			
Mexican American	**569**	**20**	176	31.37	2.31**	1.84	2.91	3.07**	2.33	4.05	Mexican American	208	37.1	3.30**	2.61	4.17	4.29**	3.26	5.64
Other Hispanic	**94**	**3**	32	5.70	2.67**	1.70	4.19	3.29**	2.02	5.37	Other Hispanic								
Non-Hispanic White	**1326**	**47**	215	38.32	ref			ref			Non-Hispanic White	312	55.6	ref					
Non-Hispanic Black	**680**	**24**	97	17.29	0.86	0.66	1.12	1.05	0.79	1.39	Non-Hispanic Black								
Other Race or Multiracial	**138**	**5**	41	7.31	2.18**	1.47	3.24	2.37**	1.57	3.57	Other Race or Multiracial	41	7.3	2.41**	1.62	3.59	2.24**	1.38	3.63
Education Level																			
Less Than 9th Grade	**187**	**7**	47	8.49	ref			ref				560	100.0	1.21**	1.10	1.33	1.36**	1.26	1.47
9th to 11th Grade	**476**	**15**	88	13.77	0.42**	0.29	0.62	0.77	0.51	1.17									
High School, GED	**707**	**24**	113	19.81	0.35**	0.24	0.50	0.73	0.49	1.11									
Some College or AA Degree	**841**	**31**	165	30.19	0.49**	0.35	0.70	1.13	0.76	1.70									
College Graduate or Above	**595**	**24**	147	27.74	0.66*	0.46	0.94	1.59*	1.02	2.48									
Marital Status																			
Married	**1458**	**52**	343	61.25	ref			ref			Married	343	61.3	ref					
Widowed	**75**	**3**	18	3.21	1.03	0.60	1.77	0.72	0.40	1.30	Divorced	48	8.6	0.61**	0.43	0.87	0.52**	0.36	0.75
Divorced	**264**	**9**	48	8.57	0.72	0.52	1.01	0.61**	0.42	0.87	Widowed								
Separated	**76**	**3**	17	3.04	0.94	0.54	1.63	0.78	0.43	1.44	Separated	169	30.2	0.75**	0.60	0.94	0.77	0.55	1.08
Never married	**676**	**24**	92	16.43	0.51**	0.40	0.66	0.70*	0.51	0.96	Never married								
Living with partner	**256**	**9**	42	7.50	0.64*	0.45	0.91	0.78	0.53	1.14	Living with partner								
Annual Household Income																			
$0 to $14,999	**341**	**13**	72	0.14	ref			ref			$0 to $14,999								
$15,000 to $34,999	**727**	**27**	159	0.30	1.05	0.76	1.43	0.79	0.56	1.11	$15,000 to $34,999	332	0.63	ref					
$35,000 to $54,999	**535**	**20**	101	0.19	0.87	0.62	1.22	0.71	0.49	1.03	$35,000 to $54,999								
$55,000 to $74,999	**401**	**15**	59	0.11	0.65*	0.44	0.94	0.49**	0.32	0.74		59	0.11	0.61**	0.44	0.83	0.58*	0.38	0.87
$75,000 and Over	**685**	**25**	139	0.26	0.95	0.69	1.31	0.64*	0.44	0.94		139	0.26	0.85	0.66	1.10	0.91	0.71	1.16

*p<0.05, **p<0.01

‡missing data, income refusals

Table 17. 39 Category Output Demographics Models, Western Pattern Only

	Totals		Unadjusted					Adjusted				Final Model					Weighted Final Model			
total n=2804								n=2783												
Gender	**Freq**	**%**	**Freq**	**%**	**OR**	**95%CI**		**AOR**	**95%CI**				**AOR**	**95%CI**			**AOR**	**95%CI**		
Male	**1235**	**44**	304	54.2	ref			ref					ref							
Female	**1572**	**56**	257	45.8	0.60**	0.50	0.72	0.54**	0.44	0.65			0.54**	0.44	0.66		0.38**	0.28	0.50	
Age at Screening																				
18-24	**567**	**20**	193	34.4	ref			ref					0.97**	0.96	0.97		0.97**	0.96	0.98	
25-39	**813**	**29**	177	31.6	0.54**	0.42	0.69	0.65**	0.48	0.86			(10 year increments)							
40-54	**781**	**28**	116	20.7	0.34**	0.26	0.44	0.36**	0.26	0.49										
55-69	**646**	**23**	75	13.4	0.26**	0.19	0.34	0.24**	0.16	0.35										
Race/Ethnicity																				
Mexican American	**569**	**20**	85	15.2	0.85	0.65	1.12	0.52**	0.38	0.71	Mexican American		0.54**	0.41	0.72		0.51**	0.31	0.84	
Other Hispanic	**94**	**3**	20	3.6	1.31	0.78	2.19	0.84	0.48	1.47	Non-Hispanic Black		1.81**	1.45	2.26		1.83**	1.33	2.53	
Non-Hispanic White	**1326**	**47**	227	40.5	ref			ref			Other Hispanic									
Non-Hispanic Black	**680**	**24**	209	37.3	2.15**	1.73	2.67	1.68**	1.32	2.13	Non-Hispanic White		ref							
Other Race or Multiracial	**138**	**5**	20	3.6	0.82	0.50	1.35	0.78	0.47	1.31	Other Race or Multiracial									
Education Level																				
Less Than 9th Grade	**187**	**6.66**	37	7.4	ref			ref			Less Than 9th Grade									
9th to 11th Grade	**476**	**16.96**	128	19.8	1.50	0.99	2.26	0.83	0.53	1.31	9th to 11th Grade		ref							
High School, GED	**707**	**25.20**	177	30.1	1.36	0.91	2.02	0.82	0.53	1.29	High School, GED									
Some College or AA Degree	**841**	**29.97**	154	28.5	0.91	0.61	1.36	0.54**	0.34	0.86			0.62**	0.50	0.78		0.64**	0.51	0.81	
College Graduate or Above	**595**	**21.20**	64	14.3	0.49**	0.31	0.76	0.39**	0.23	0.65			0.43**	0.32	0.59		0.42**	0.30	0.58	
Marital Status																				
Married	**1458**	**52**	227	40.5	ref			ref												
Widowed	**75**	**3**	13	2.3	1.14	0.62	2.10	1.70	0.87	3.31										
Divorced	**264**	**9**	39	7.0	0.94	0.65	1.36	0.96	0.65	1.42										
Separated	**76**	**3**	15	2.7	1.33	0.75	2.39	0.89	0.47	1.71										
Never married	**676**	**24**	204	36.4	2.34**	1.89	2.91	1.11	0.83	1.47										
Living with partner	**256**	**9**	63	11.2	1.77**	1.29	2.43	1.02	0.72	1.45										
Annual Household Income																				
$0 to $14,999	**341**	**13**	99	18.5	ref			ref			$0 to $14,999									
$15,000 to $34,999	**727**	**27**	155	29.0	0.66**	0.49	0.89	0.85	0.62	1.17	$15,000 to $34,999		ref							
$35,000 to $54,999	**535**	**20**	109	20.4	0.63**	0.46	0.86	0.78	0.55	1.10	$35,000 to $54,999									
$55,000 to $74,999	**401**	**15**	75	14.0	0.56**	0.40	0.79	0.77	0.53	1.12	$55,000 to $74,999									
$75,000 and Over	**685**	**25**	96	18.0	0.40**	0.29	0.55	0.66*	0.46	0.95			0.78‡	0.60	1.02		0.77	0.55	1.09	

*p<0.05, **p<0.01, ‡p=0.06

Race and ethnicity effects were similar for the healthy diet pattern in the adjusted model. The Mexican American and other Hispanic groups were collapsed based on similar odds ratios, as were the non-Hispanic white and non-Hispanic black groups. For the Western pattern, other Hispanic, non-Hispanic white, and other race/multiracial were collapsed into the reference group. Odds ratios close to 1.0 were similarly collapsed for the education subgroups. Education level was included as a continuous variable the final healthy pattern model, but the lack of linearity in the education subgroup adjusted odds ratios for the Western pattern resulted in the three lowest education strata to be collapsed for the final model. All strata except married and divorced were collapsed for the healthy pattern final model, while no marital status variables were included in the final Western model due to the lack of significant findings in the adjusted model. In the final model predicting adherence to the healthy diet pattern based on demographic variable predictors, women were 1.5 times more likely than men to report following a healthy diet pattern. The effect of age was slight; each increase of 10 years made an individual 1.02 times more likely to follow the healthy diet pattern. The group comprising Mexican Americans and other Hispanics and respondents in the other race/multiracial group were the most likely of any demographic subgroups to follow the healthy pattern (AOR 3.30 and 2.41 respectively) when compared to the reference group comprising both whites and blacks. Each increase in education subgroup was associated with a 1.2 times greater likelihood of following the healthy diet pattern. Widowed Americans were

0.61 times as likely as married Americans to follow the healthy diet pattern, and all other marital status subgroups were 0.75 times as likely to follow the healthy pattern when compared to those who were married. Respondents with household income between $55,000 and $74,999 were 0.61 times as likely to follow the healthy diet pattern with individuals in the lowest three income categories comprising the reference group. All odds ratios in the final model were significant at the $p<0.01$ level.

Dietary Recall Variables Univariate Statistics

Only the cohorts resulting from the intermediate analysis (39 variable grouping) were carried forward to be merged with 24-hour diet recall data. As discussed in the Methods section, this decision was based on an inspection of the output of the factor analyses from the three variable grouping schemes. The ungrouped analysis contained too many factors above the 1.25 eigenvalue cutoff, and the 23 variable category grouping did not preserve enough of the detail in the dataset to produce meaningful factors, due to multiple food types with different nutritional profiles (e.g. fried and unfried chicken) to be included in the same variable category. The 23 category grouping also produced only two factors with eigenvalues above 1.0. The 39 category output produced readily interpretable factors with sufficient detail to divide respondents into meaningful response groups.

These cohorts included all individuals in the top quintile of either the Western or healthy pattern (factors 1 and 2, respectively). Variables from 24-

hour diet recall data used in the next step of the analysis included number of eating occasions, diet score (number of food groups represented), total Calories per day, eating location, and whether or not breakfast was skipped. Univariate statistics and demographic variables for all 24-hour dietary recall variables used in the analysis are reported in

. Most variables followed either the normal distribution or were right-skewed (most respondents answering in the lower numbers). A low Calorie cutoff was established at 200 cal/day to exclude unrealistically low responses. [103] Roughly three quarters of respondents fell within 1000-3000 Calories per day. Diet scores had a roughly normal distribution, with about half of respondents having diet scores of 5 or 6, meaning that 5 or 6 major food groups were represented on the first day of dietary recall. Over half of respondents (62.6%) had 4 to 6 eating occasions per day; the total eating occasions variable also followed a roughly normal distribution.

Table 18.Dietary Habits Frequencies
total n=2804*

Cal/day (n=2804)	Freq	%
200-999	186	6.6
1000-1999	1135	40.5
2000-2999	962	34.3
3000-3999	364	13.0
4000-4999	112	4.0
5000-8550	45	1.6
Diet Score (# food groups		
2	23	0.8
3	100	3.6
4	280	10.0
5	593	21.2
6	773	27.6
7	690	24.6
8	296	10.6
9	49	1.8
Total Eating Occasions		
1	6	0.2
2	67	2.4
3	252	9.0
4	574	20.5
5	663	23.6
6	520	18.5
7	337	12.0
8	199	7.1
9	104	3.7
10	48	1.7
11-14	34	1.2
Breakfast (total items)		
0-2	1332	47.5
3-4	762	27.2
5-6	452	16.1
7-8	180	6.4
9-10	62	2.2
11-12	10	0.4
13-16	6	0.2
Lunch		
0-2	1062	37.9
3-4	650	23.2
5-6	504	18.0
7-8	306	10.9
9-10	158	5.6
11-12	67	2.4
13-15	36	1.3
16-22	21	0.8

Dinner	Freq	%
0-2	653	23.3
3-4	763	27.2
5-6	607	21.7
7-8	365	13.0
9-10	216	7.7
11-12	105	3.8
13-15	61	2.2
16-25	34	1.2
Brunch		
0-2	2737	97.6
3-4	30	1.1
5-6	20	0.7
7-8	10	0.4
9-12	7	0.3
Snack		
0-2	1560	55.6
3-4	663	23.6
5-6	323	11.5
7-8	161	5.7
9-10	62	2.2
11-12	23	0.8
13-21	12	0.4
Drink		
0-2	2430	86.7
3-4	284	10.1
5-6	65	2.3
7-10	25	0.9
Extended		
0-2	2708	96.6
3-4	81	2.9
5-6	10	0.4
7-8	4	0.1
10-11	1	0.0

*three individuals excluded due to low calorie intake (<200 kcal/day)

Dietary Recall Variables by Demographic Group

Comparison of means by ANOVA (Table 19) showed women with significantly lower daily caloric intake than men (1905 vs. 2640 mean Calories per day, $p<0.01$). Daily caloric intake was lowest in the highest age group (1945 mean Calories per day for ages 55-69).

Table 19. Dietary Recall Demographics

	Totals				Food Source (respondents with at least one item, day 1)																			
					Store		Restaurant, Bar, Cafeteria		Residential Dining, Comm. Food Program		Other Vending or Eating Out		Gift, Mail Order		Grown/ Caught		Other		Mean # Eating occasions	Mean # snacking occasions	No snacks		Skipped breakfast	
	Freq	%	Mean cal/day	Mean Diet Score	Freq	%	Freq	%	Freq	%	Freq	%	Freq	%	Freq	%	Freq	%			Freq	%	Freq	%
Total	**2804**		2229	6.0	2777	98.9	1565	55.8	23	0.8	459	16.4	678	24.2	147	5.2	12	0.4	5.5	2.7	622	22.2	750	26.7
Gender (n=2804)																								
Male	**1235**	44.0	2640	5.9	1226	99.3	715	57.9*	10	0.8	237	19.2	290	23.5**	70	5.7	4	0.3	5.5	2.6	315	25.5	351	28.4
Female	**1569**	56.0	1905**	6.0	1551	98.9	850	54.2	13	0.8	222	14.1	388	24.7	77	4.9	8	0.5	5.5	2.8*	307	19.6	399	25.4
Age at Screening† (n=2804)																								
18-24	**566**	20.2	2339	5.5	558	98.6	364	64.3**	4	0.7	71	12.5**	114	20.1**	8	1.4**	0	0.0	5.0**	2.6	133	23.5**	236	41.7**
25-39	**812**	29.0	2356	5.9**	803	98.9	473	58.3	5	0.6	146	18.0	202	24.9	31	3.8	3	0.4	5.6	2.7	189	23.3	244	30.0
40-54	**780**	27.8	2252**	6.0**	775	99.4	442	56.7	4	0.5	161	20.6	201	25.8	46	5.9	4	0.5	5.7	2.7	171	21.9	170	21.8
55-69	**646**	23.0	1945	6.3	643	99.5	286	44.3	10	1.5	81	12.5	161	24.9	62	9.6	5	0.8	5.6	2.8	129	20.0	100	15.5
Race/Ethnicity (n=2807)																								
Mexican American	**569**	20.3	2189	6.0	565*	99.3	284	49.9**	2	0.4	100	17.6**	136	23.9**	19	3.3**	1	0.2	5.3	2.6	155	27.2**	297	52.2**
Other Hispanic	**94**	3.4	2105	5.9	93	98.9	45	47.9	2	2.1	14	14.9	22	23.4	1	1.1	2	2.1	5.4	2.6	18	19.1	46	48.9
Non-Hispanic White	**1326**	47.2	2274	6.1	1316	99.2	744	56.1	11	0.8	209	15.8	354	26.7	108	8.1	7	0.5	5.8**	2.8	256	19.3	210	15.8
Non-Hispanic Black	**680**	24.2	2239	5.7**	665	97.8	407	59.9	8	1.2	120	17.6	136	20.0	14	2.1	2	0.3	5.0**	2.8	152	22.4	171	25.1
Other Race or Multiracial	**138**	4.9	1998**	6.1	138	100.0	85	61.6	0	0.0	16	11.6	30	21.7	5	3.6	0	0.0	5.4	2.3	41	29.7	26	18.8
Education Level (n=2803)																								
Less Than 9th Grade	**187**	7	2037	5.8	186	99.5	61	32.6**	1	0.5	27	14.4**	30	16.0**	15	8.0**	1	0.6	5.0	2.2	62	33.2**	126	67.4**
9th to 11th Grade	**475**	17	2293	5.8	468	98.5	256	53.9	4	0.8	72	15.2	92	19.4	16	3.4	2	0.6	5.0	2.6	113	23.8	122	25.7
High School, GED	**706**	25	2248	5.7	695	98.4	406	57.5	7	1.0	94	13.3	148	21.0	41	5.8	2	0.3	5.3	2.6	170	24.1	165	23.4
Some College or AA Degree	**841**	30	2223	6.0	836	99.4	478	56.8	7	0.8	170	20.2	220	26.2	37	4.4	4	0.5	5.6	2.9	175	20.8	142	16.9
College Graduate or Above	**594**	21	2227	6.4	591	99.5	364	61.3	4	0.7	96	16.2	188	31.6	38	6.4	3	0.5	6.1	2.9	102	17.2	66	11.1
Marital Status (n=2805)																								
Married	**1457**	52	2241	6.2	1446	99.2	800	54.9**	4	0.3	263	18.1**	374	25.7**	106	7.3**	6	0.4	5.7	2.8	325	22.3**	342	23.5**
Widowed	**75**	3	1929	5.9	74	98.7	33	44.0	2	2.7	5	6.7	23	30.7	4	5.3	1	0.4	5.6	2.9	8	10.7	9	12.0
Divorced	**264**	9	1895	6.3	263	99.6	121	45.8	4	1.5	37	14.0	59	22.3	8	3.0	1	1.3	5.6	2.7	55	20.8	49	18.6
Separated	**76**	3	2404	5.8	76	100.0	46	60.5	1	1.3	9	11.8	17	22.4	2	2.6	1	1.3	5.4	2.8	20	26.3	21	27.6
Never married	**676**	24	2294	5.6	663	98.1	418	61.8	10	1.5	105	15.5	154	22.8	21	3.1	1	0.2	5.1	2.7	140	20.7	232	34.3
Living with partner	**256**	9	2347	5.7	253	98.8	146	57.0	2	0.8	40	15.6	51	19.9	5	2.0	1	0.4	5.1	2.5	74	28.9	97	37.9
Annual HH Income (n=2686)																								
$0 to $14,999	**341**	12	2141	5.7	336	98.5	156	45.7**	9	2.6	37	10.9**	74	21.7**	18	5.3**	3	0.9	5.1	2.7	78	22.9**	125	36.7**
$15,000 to $34,999	**725**	26	2189	5.8	718	99.0	353	48.7	6	0.8	111	15.3	152	21.0	34	4.7	3	0.4	5.3	2.7	183	25.2	269	37.1
$35,000 to $54,999	**535**	19	2271	5.9	526	98.3	305	57.0	3	0.6	93	17.4	140	26.2	23	4.3	1	0.2	5.5	2.7	122	22.8	123	23.0
$55,000 to $74,999	**401**	14	2275	6.1**	400	99.8	235	58.6	1	0.2	55	13.7	95	23.7	21	5.2	2	0.5	5.5	2.6	98	24.4	78	19.5
$75,000 and Over	**684**	25	2235	6.2**	679	99.3	443	64.8	2	0.3	144	21.1	196	28.7	46	6.7	1	0.2	5.9	2.8	121	17.7	107	15.6

ANOVA **p<0.01, *p<0.05

Mean diet score (the number of food groups represented on the first day of 24-hour recall data) averaged 6.0 for the entire cohort. Mean diet score was lowest in the youngest age group (18-24 years, diet score 5.5) and highest in the middle two age groups, 25-39 years (5.9) and 40-54 (6.0). Non-Hispanic blacks had the lowest mean diet score (5.7). Mean diet score was highest (6.1 and 6.2) in the uppermost income strata ($55,000-$74,999 and $75,000 and above, respectively). All reported differences were significant at the $p<0.01$ level.

For food source variables, the majority of respondents (99%) obtained food from a store, and very few individuals (0.8%) obtained food from residential dining or community food programs, which were reported as a single combined category. Significant differences were found across all demographic groups among individuals reporting restaurants, bars or cafeterias (combined category) as a food source. Men were more likely than women to obtain food from these sources (58% vs. 54%, respectively), and there was a decreasing gradient (64% to 44%) for each increasing age category. Mexican Americans (50%) and other Hispanics (48%) were least likely to obtain food from restaurants and bars, while non-Hispanic blacks and people of other races were most likely (60-62%). A decreasing gradient was found with increasing education level (33% to 61% between the lowest and highest education strata). Individuals who were separated or never married were most likely to eat at restaurants and bars (61%, 62% respectively), while those who were widowed or divorced were least likely (44% and 46%). Eating out was positively correlated with increasing income, ranging from 46% at the lowest income level to 65% at the highest.

Individuals aged 40-54 (21%), individuals with some college education or an associate's degree (20%), those who were married (18%) and those in the highest income group (21%) were most likely to report obtaining food items from other sources outside the home including sporting events, entertainment venues or vending machines. All reported differences were significant at the $p<0.01$ level.

About one quarter of the sample (24%) obtained food from gifts or by mail order, with men slightly more likely than women to obtain food from this source. There was a strong correlation with education level, with individuals with less than a high school education reporting food from gifts or by mail order for less than 20 percent of reported food items, and at least 26% for those with at least some college education. Married or widowed respondents were most likely to obtain food from gifts or mail order (26% and 31%, respectively). There was a slight correlation with income level, ranging from 22% to 29% between the lowest and highest income groups.

The mean number of eating occasions for the sample was 5.5. No demographic subgroups showed significant differences with this measure except for 18-24 year olds and black Americans having fewer than average eating occasions (5.0 for both), while whites had slightly more eating occasions on average (5.8). The mean number of snacking occasions was 2.7 snack items reported daily. Women snacked slightly more often than men (2.8 vs. 2.6). About 22% of the study sample reported no snack items on the first day of dietary recall. Men (26%) were more likely to have no snacks reported than women (20%). Younger respondents were slightly more likely not to report any snacks

(24% vs. 20% for the oldest age group). Mexican Americans and those responding as "other race or multiracial) were most likely to report no snacks (27% and 30%, respectively) while other Hispanics and non-Hispanic whites were least likely to skip snacks (19%). One third of those at the lowest education level reported no snacks (33%), while only 17% of college graduates reported no snacks. Individuals who were separated (26%) or living with a partner (29%) were most likely to report not snacking, while those who were widowed were by far the least likely of all marital statuses to report no snacking (11%). Respondents in the highest income bracket were least likely to report not snacking (18%). Younger age groups were more likely than older age groups to have no snacking occasions reported, but not by a wide margin (20.0% to 23.5% reporting no snacks across all age groups).

About one quarter of respondents (27%) skipped breakfast, with slightly more men than women skipping breakfast (28% and 25% respectively). The highest percentage of breakfast skippers (42%) were in the youngest age group (18-24 years). Breakfast skipping declined with each increasing age group, with only 16% of 55-69 year olds skipping breakfast. About half of Mexican Americans and other Hispanics (52% and 49% respectively) skipped breakfast, while only 16% of whites skipped breakfast. Black Americans skipped breakfast slightly less than average (25%). Over two thirds (67%) of individuals with the lowest level of educational attainment skipped breakfast, and the lowest levels of breakfast skipping were found at the two highest education strata (17% and 11%). Widowed and divorced respondents were least likely to skip breakfast (12% and

19% respectively) while those who were never married (34%) and living with a partner (38%) were most likely to skip breakfast. The two lowest income strata each had over one third of breakfast skippers, with breakfast skipping declining to 16% at the highest income group.

Comparison of Top Factors, Final Dietary Habits Models

Results for total caloric intake were highly significant and in expected directions for strong adherents of the healthy and Western dietary patterns. There was no significant difference in these findings between the weighted and unweighted models. Both mean Calories per day and diet score showed a roughly linear relationship in the adjusted models and were converted to continuous variables for the final model. Increasing caloric intake was inversely associated with strong adherence to the healthy dietary pattern (AOR 0.79 for each increase of 100 Calories per day, $p<0.01$). Increasing caloric intake was associated with an increased likelihood of being a strong adherent of the Western pattern (AOR 1.56 for each increase of 100 Calories per day, $p<0.01$, see Tables 20-22).

Table 20. 39 Category Output, Top Factors, Final Dietary Habits Models

total n=2804	Totals		Final Model Factor 1 (Healthy)			Final Weighted Model			Final model Factor 2 (Western)			Final Weighted Model		
	Freq	%	AOR	95% CI		AOR	95% CI		AOR	95% CI		AOR	95% CI	
Mean cal/day														
200-1199	317.0	11.3	0.79**	0.71	0.87	0.78**	0.70	0.88	1.56**	1.43	1.71	1.67**	1.48	1.89
1200-1999	1004.0	35.8	(continuous, 100 cal increments)						(continuous, 100 cal increments)					
2000-2999	962.0	34.3												
3000-3999	364.0	13.0												
4000-4999	112.0	4.0												
5000-8550	45.0	1.6												
Diet Score (food groups														
2-3	123	4.4	1.33**	1.23	1.44	1.34**	1.23	1.47	0.79**	0.74	0.86	0.82**	0.74	0.90
4	280	10.0												
5	593	21.2												
6	773	27.6												
7	690	24.6												
8-9	345	12.3												
Food Source														
Restaurant, Bar, Cafeteria	1565	55.8	0.63**	0.52	0.77	0.70**	0.57	0.86						
Other Vending or Eating Out	459	16.4												
Gift. Mail Order	678	24.2							0.80‡	0.63	1.01	0.74**	0.60	0.91
Grown/Caught	147	5.2							0.60‡‡	0.35	1.02	0.68	0.31	1.47
# Eating occasions														
1-2	73	2.6							0.83**	0.77	0.89	0.85**	0.81	0.89
3	252	9.0												
4	574	20.5												
5	663	23.6												
6	520	18.5												
7	337	12.0												
8	199	7.1												
9-14	186	6.6												
# snacks														
0	622	22.2	ref			ref			ref			ref		
1-2	938	33.5	0.62**	0.48	0.81	0.65*	0.43	0.97	1.21	0.93	1.57	1.24	0.90	1.69
3-4	663	23.6	0.91	0.69	1.20	1.04	0.69	1.55	3-4					
5-6	323	11.5	0.78	0.55	1.11	0.81	0.52	1.25	5-6	1.13	0.85	1.50	1.12	0.84	1.50
7-8	161	5.7	1.13	0.79	1.61	1.27	0.79	2.06	7-8						
9-21	97	3.5							1.83*	1.03	3.25	0.87	0.47	1.60
Skipped breakfast	750	26.7	1.49**	1.20	1.84	1.29**	1.07	1.57						

*p<0.05, **p<0.01 ‡p=0.0574, ‡‡p=0.059

Table 21. 39 Category Output, Final Dietary Habits Models, Healthy Pattern Only

	Totals		Unadjusted			Adjusted				Final Model			Final Weighted Model		
total n=2804															
	Freq	**%**	**OR**	**95% CI**		**AOR**	**95% CI**			**AOR**	**95% CI**		**AOR**	**95% CI**	
Mean cal/day															
200-1199	317.0	11.3	ref			ref									
1200-1999	1004.0	35.8	0.90	0.67	1.21	0.78	0.57	1.07		0.79**	0.71	0.87	0.78**	0.70	0.88
2000-2999	962.0	34.3	0.69	0.51	0.94	0.57**	0.41	0.78		(continuous, 100 cal increments)					
3000-3999	364.0	13.0	0.68	0.47	0.98	0.52**	0.35	0.77							
4000-4999	112.0	4.0	0.41	0.22	0.77	0.32**	0.17	0.62							
5000-8550	45.0	1.6	0.39	0.15	1.02	0.26**	0.10	0.71							
Diet Score (food groups represented)															
2-3	123	4.4	ref			ref									
4	280	10.0	0.96	0.50	1.84	1.03	0.53	2.01		1.33**	1.23	1.44	1.34**	1.23	1.47
5	593	21.2	1.51	0.85	2.70	1.83*	1.00	3.35							
6	773	27.6	1.84*	1.04	3.24	2.40**	1.32	4.37							
7	690	24.6	2.12**	1.20	3.75	2.94**	1.61	5.37							
8-9	345	12.3	2.74**	1.52	4.93	3.71**	1.97	6.99							
Food Source															
Restaurant, Bar, Cafeteria	1565	55.8	0.59**	0.49	0.71	0.63**	0.52	0.77	Restaurant, Bar, Cafeteria	0.63**	0.52	0.77	0.70**	0.57	0.86
Other Vending or Eating Out	459	16.4	0.81	0.62	1.05	0.86	0.65	1.13							
Gift, Mail Order	678	24.2	1.01	0.81	1.25	0.97	0.77	1.21							
Grown/Caught	147	5.2	1.27	0.86	1.88	1.01	0.67	1.52							
# Eating occasions															
1-2	73	2.6	ref			ref									
3	252	9.0	1.11	0.57	2.19	1.12	0.56	2.25							
4	574	20.5	1.07	0.57	2.02	1.22	0.62	2.40							
5	663	23.6	1.05	0.56	1.98	1.30	0.66	2.58							
6	520	18.5	1.17	0.62	2.21	1.44	0.71	2.91							
7	337	12.0	1.15	0.59	2.21	1.41	0.68	2.93							
8	199	7.1	1.72	0.88	3.38	2.12††	1.00	4.49							
9-14	186	6.6	1.31	0.65	2.61	1.50	0.69	3.27							
# snacks															
0	622	22.2	ref			ref			0	ref			ref		
1-2	938	33.5	0.66**	0.51	0.86	0.58**	0.44	0.77	1-2	0.62**	0.48	0.81	0.65*	0.43	0.97
3-4	663	23.6	0.96	0.73	1.25	0.81	0.59	1.10	3-4	0.91	0.69	1.20	1.04	0.69	1.55
5-6	323	11.5	0.85	0.61	1.19	0.67*	0.45	0.98	5-6	0.78	0.55	1.11	0.81	0.52	1.25
7-8	161	5.7	1.08	0.72	1.63	0.83	0.52	1.31	7-21	1.13	0.79	1.61	1.27	0.79	2.06
9-21	97	3.5	1.57†	0.98	2.51	1.19	0.70	2.04							
Skipped breakfast	750	26.7	1.28*	1.04	1.57	1.56**	1.25	1.95		1.49**	1.20	1.84	1.29**	1.07	1.57

*p<0.05, **p<0.01 †p=0.06 ††p=0.0504

Table 22. 39 Category Output, Final Dietary Habits Models, Western Pattern Only

total n=2804

	Totals		Unadjusted			Adjusted				Final model			Final Weighted Model		
	Freq	**%**	**OR**	**95% CI**		**AOR**	**95% CI**			**AOR**	**95% CI**		**AOR**	**95% CI**	
Mean cal/day															
200-1199	317	11.3	ref			ref				1.56**	1.43	1.71	1.67**	1.48	1.89
1200-1999	1004	35.8	0.82	0.58	1.16	1.06	0.74	1.53		(continuous, 100 cal increments)					
2000-2999	962	34.3	1.28	0.92	1.79	1.95**	1.36	2.80							
3000-3999	364	13.0	2.36**	1.63	3.41	3.94**	2.63	5.89							
4000-4999	112	4.0	2.08**	1.26	3.44	3.51**	2.05	6.00							
5000-8550	45	1.6	3.64**	1.88	7.05	6.73**	3.31	13.70							
Mean Diet Score															
2-3	123	4.4	ref			ref				0.79**	0.74	0.86	0.82**	0.74	0.90
4	280	10.0	0.71	0.45	1.12	0.75	0.46	1.21							
5	593	21.2	0.60*	0.40	0.92	0.61*	0.39	0.96							
6	773	27.6	0.50**	0.33	0.75	0.51**	0.33	0.80							
7	690	24.6	0.36**	0.23	0.55	0.34**	0.21	0.54							
8-9	345	12.3	0.36**	0.22	0.57	0.34**	0.20	0.58							
Food Source															
Restaurant, Bar, Cafeteria	1565	55.8	0.85††	0.70	1.03	1.03	0.84	1.25							
Other Vending or Eating Out	459	16.4	1.22	0.94	1.59	0.86	0.65	1.13							
Gift, Mail Order	678	24.2	1.35**	1.08	1.70	0.79*	0.62	1.00		0.80‡	0.63	1.01	0.74**	0.60	0.91
Grown/Caught	147	5.2	2.11**	1.25	3.58	0.56*	0.32	0.96		0.60‡‡	0.35	1.02	0.68	0.31	1.47
Mean # Eating occasions															
1-2	73	2.6	ref			ref				0.83**	0.77	0.89	0.85**	0.81	0.89
3	252	9.0	0.67	0.39	1.15	0.65	0.37	1.15							
4	574	20.5	0.44**	0.27	0.75	0.40**	0.23	0.69							
5	663	23.6	0.36**	0.21	0.59	0.31**	0.17	0.55							
6	520	18.5	0.41**	0.24	0.68	0.33**	0.18	0.61							
7	337	12.0	0.26**	0.15	0.46	0.20**	0.11	0.39							
8	199	7.1	0.38**	0.21	0.68	0.28**	0.14	0.55							
9-14	186	6.6	0.24**	0.13	0.45	0.17**	0.08	0.36							
Mean # snacks															
0	622	22.2	ref			ref				ref			ref		
1-2	938	33.5	0.96	0.75	1.22	1.35*	1.02	1.78		1.21	0.93	1.57	1.24	0.90	1.69
3-4	663	23.6	0.79	0.60	1.04	1.24	0.90	1.71	3-4						
5-6	323	11.5	0.67*	0.47	0.96	1.08	0.72	1.62	5-6	1.13	0.85	1.50	1.12	0.84	1.50
7-8	161	5.7	0.92	0.60	1.41	1.56	0.96	2.53	7-8						
9-21	97	3.5	1.11	0.67	1.84	1.81*	1.02	3.24		1.83*	1.03	3.25	0.87	0.47	1.60
Skipped breakfast	750	26.7	1.17	0.95	1.43	0.85	0.68	1.07							

*p<0.05, **p<0.01
†p=0.06
††p=0.08
‡p=0.0574
‡‡p=0.059

In this analysis the diet score or number of food groups represented on day 1 of dietary recall was used as a measure of dietary diversity, and roughly linear trends were observed showing that individuals who consume more Calories, and have less variety in their diet (a lower diet score) are more likely to be strong adherents of the Western dietary pattern. Opposing trends were seen regarding adherence to the healthy diet pattern. Each increase of one unit for diet score (number of food groups represented on day 1 of dietary recall) was associated with a 1.33 times increase in likelihood of being a strong adherent of the healthy diet pattern, while each increase of one unit of diet score was associated with a 0.79 times decreased likelihood of following the Western pattern ($p<0.01$).

In the healthy pattern models, the "restaurant, bar, cafeteria" variable was the only food source variable with significant findings in the adjusted model. Obtaining food from this source on day 1 of dietary recall was associated with a 0.63 times decreased likelihood of following the healthy diet pattern ($p<0.01$). In the western pattern models, obtaining food by gift or mail order was associated with a 0.80 times decreased likelihood of following the Western pattern, and those who obtained food by growing or catching it were 0.60 times less likely to follow the Western pattern. These latter two values were marginally significant, with $p=0.057$ for the first value and $p=0.059$ for the second. Eating out is deserving of special attention during collection of diet data since it is associated with higher caloric intake[63] and body fatness[118]. Strong adherents of the

healthy pattern were about half as likely to eat out, although no significant association was seen between eating out and the Western dietary pattern.

The number of eating occasions was not significant in the final model for the healthy eating pattern. For the Western pattern, a roughly linear relationship was observed in the adjusted model. The group with the highest number of eating occasions (9-14) was least likely to follow the Western dietary pattern (AOR 0.17, $p<0.01$). The number of eating occasions was included as a continuous variable in the final model, where each increase in the number of eating occasions was associated with a 0.83 times decreased likelihood of following the Western pattern ($p<0.01$). Individuals who skipped breakfast were about 1.5 times more likely to follow the healthy diet pattern than those who didn't ($p<0.01$), and there was no significant result with regard to breakfast skipping and the Western dietary pattern. Younger age groups were much more likely to skip breakfast.

Those consuming 1-2 snack items on day 1 of dietary recall were 0.62 times less likely to follow the healthy diet pattern when compared to those who had no snacks ($p<0.01$). In the final Western model, individuals in the highest snacking group (identifying 9-21 snack items on day 1 of dietary recall) were 1.83 times as more likely to be strong adherents of the Western diet pattern when compared to those who reported no snacks ($p<0.05$).

Mexican Americans and other Hispanics were over three times more likely to follow the healthy eating pattern than the control group in the final model, which included whites and blacks. In the Western pattern model these groups

were divided - Mexican Americans were half as likely to follow the Western pattern, but other Hispanics were almost twice as likely to follow it. Mexican Americans were least likely of any ethnic group to eat out, but most likely to skip breakfast, and among the most likely to report consuming no snack items

Each successively higher level of education was 1.2 times more likely than the last to follow the healthy eating pattern. In the Western pattern model, the highest education strata were about half as likely to follow the Western pattern. For income, the main significant result in the final model for healthy eating was a decreased likelihood (AOR 0.61) of following the healthy pattern for the next to highest income group ($55,000 to $74,999). The highest income bracket ($75,000 and over) was less likely to follow the unhealthy Western diet pattern (AOR 0.79).

DISCUSSION, POLICY IMPLICATIONS

These analyses expanded the scope of diet patterns commonly found in epidemiologic studies, uncovering previously unreported associations between certain demographic subgroups and following healthy or unhealthy diet patterns, and also between several dietary habits and these patterns. We will review our most significant findings and then discuss them in the context of the literature as it pertains to health education and health policy relevance.

Among the expected results in the final demographic models in this analysis were the findings that men are more likely to follow the Western pattern,

and women were more likely to follow the healthy diet pattern. The effect of age was slight but in expected directions, with older Americans being more likely to follow a healthy diet pattern. Mexican Americans and other Hispanics were much less likely, and black Americans much more likely than other ethnicities to follow the Western diet pattern. Mexican Americans and other Hispanics were several times more likely to follow the healthy pattern as those in other ethnic groups. Findings regarding education level were also as expected, with a clear linear relationship showing increased likelihood of following the healthy pattern with each increasing level of education, and the two top education groups being about half as likely as those in all other education categories to follow the Western pattern. Widowed individuals were less likely to follow the healthy diet pattern, as were individuals of all other marital statuses, compared to those who were married. Finally, the highest earning individuals were both less likely to follow the healthy diet pattern and less likely to follow the western pattern, when compared to all other income groups.

Increasing daily energy had a strong positive association with the Western pattern, and a strong negative association with the healthy pattern. Increasing dietary diversity was positively associated with the healthy pattern and inversely associated with the Western pattern. Eating out at a restaurant or bar was associated with a lower likelihood of following the healthy pattern. While there was no corresponding significant finding in the final Western pattern model, there was a negative association with obtaining food from gifts or mail order, or from grown and caught sources. A greater number of eating occasions, including

snacking occasions, was associated with a lower likelihood of following the Western pattern with the exception of the highest frequency snacking group (9-21 snack items per day) being almost twice as likely to follow the Western pattern. Individuals reporting only 1-2 snack items per day were about half as likely to follow the healthy pattern. This analysis showed individuals who skipped breakfast as being almost 1.5 times more likely to follow the healthy diet pattern.

Health Education

One possible benefit of these results is the identification of foods and food groups to be focused on for nutrition education efforts. Men, younger age groups, black Americans, and those at lower income levels are already known to be more likely to have an unhealthy diet pattern, and these analyses provide a more detailed understanding of these relationships. For example, a more targeted approach in developing nutritional messages would specify individuals who are unmarried, separated or living with a partner as more likely to follow the Western dietary pattern and therefore at higher risk of disease.

A 2014 review of health education campaigns worldwide aimed at increasing fruit and vegetable consumption among adults showed that although most behavioral interventions have had limited success, the effectiveness of these campaigns was greater with collaboration between industry, retail, government, and nonprofit groups. Running education campaigns with a variety of modes of communication and over a long period can increase awareness of campaign messages[119], as well as emphasizing both personal and social

responsibility [120]. Another review of over 900 diet behavior change interventions found that effectiveness was greater when groups with chronic disease or at risk for chronic disease were specifically targeted for intervention, rather than general, healthy populations [121]. Furthermore, tailoring the messages of dietary interventions based on the message recipient's ethnic identity can also increase the effectiveness of a diet behavior intervention [122, 123].

The linear trends showing low dietary diversity being correlated with higher caloric consumption and increased likelihood of following the Western dietary pattern indicate the importance of encouraging dietary diversity in health education efforts. Increasing dietary diversity is already a part of nutritional guidelines both in the US and abroad as a means of ensuring adequate intake of essential nutrients. A review of 16 studies of dietary diversity worldwide found dietary diversity associated with higher household income, greater intake of essential nutrients [124]. Only a small portion of the US population eat the amount of fruits and vegetables recommended for good health [125]. Previous analyses of NHANES data have found fruit and vegetable consumption consistently below recommended dietary guidelines.[126] Nutrition education may be one way to increase fruit and vegetable consumption. [127] Dietary fruit and vegetable consumption is directly related to income at or above 400% of the poverty threshold, and is mediated by education level. One study of NHANES data from 1999-2006 found no association between fruit and vegetable intake and biomarkers of chronic disease risk, including C-reactive protein, LDL, and

HDL, although authors still recommended fruit and vegetable intake as a way to displace other possibly unhealthy calorie sources from the diet. [128]

The clear gender difference in the likelihood of following the Western and healthy diet patterns indicates the importance of finding health messages and interventions that are effective in improving diet quality in men. Turell explored the reason why women eat healthier and found that women reported enjoying the taste of fruits and vegetables better than men, were more likely than men to believe that following dietary guidelines improved one's health, and were more knowledgeable than men about food and nutrition in general [79]. Encouraging a greater number of fruit and vegetable eating occasions appears to be more effective than encouraging larger fruit and vegetable portion sizes [129].

Targeting health education messages to specific groups based on their known dietary habits may help make large-scale efforts at behavior change more inexpensive and effective. Until now relationships between eating habits (rather than specific foods or nutrients) and health are not well-established. [130] One 2010 review of over 150 articles investigating the relationship between selected eating behaviors and weight found only "small and inconsistent evidence" of any relationship between breakfast skipping, meal frequency, snacking, eating out, or high energy intake (large food portions) and excess weight. These connections were not found despite the frequency of these habits increasing among the US population roughly in tandem with the obesity epidemic. The authors also point out that the effect of some habits on obesity or health in general may be related to culture. Eating out in the US is associated with higher caloric intake and foods

of lower nutrient density, but this is not the case in some Mediterranean countries for example, where restaurants serve traditional food. [130]

It is difficult to determine specific recommendations regarding the targeting of specific ethnic groups for health interventions based on the results of this analysis. The increased likelihood of Mexican-Americans and other Hispanics following a healthy pattern may have to do with traditional Mexican dishes high in fruits and vegetables, but this finding is not consistent in other analyses. One analysis of Mexican Americans from the 2006 NHANES found several distinct eating patterns including refined foods/sweets, diverse, and traditional, and found that the traditional eating pattern was least likely to be a associated with obesity, but another analysis of 2001 NHANES data found several eating patterns within the Mexican American subgroup, all of which were associated with obesity. These findings may have resulted from differences in how meal patterns or variable groupings were defined [131, 132]. Despite the findings that Mexican Americans were least likely of any ethnic group to eat out and among the most likely to report consuming no snack items, it would not be prudent to assume that Mexican Americans should not also be included in diet-related health promotion efforts.

The finding that the highest income bracket ($75,000 and over) was less likely to follow the unhealthy Western diet pattern is contrary to the idea of chronic diseases such as cardiovascular disease being "diseases of affluence." This might be explained by the fact that the upper income bracket as defined by

NHANES encompasses those of both moderately high and very high incomes, two groups that it may be instructive to study separately.

The finding of a greater number of eating occasions being associated with a lower likelihood of following the Western diet pattern is consistent with common recommendations for increasing meal frequency as one method of weight loss, [133], although controlled feeding studies show that increased meal frequency is not actually beneficial to appetite control [134]. A literature review by Drummond et al. showed that snacking behavior may not be inherently unhealthy and may in fact contribute to healthy eating patterns [69]. In a study of respondents from NHANES years 2001-2008, Nicklas [135] classified snacks into subtypes, including cakes/cookies/pastries, vegetables/legumes, crackers/salty snacks, or other grains/whole fruit and found that many snacking subtypes contributed to overall diet quality, and that most snacking patterns were not associated with cardiovascular risk factors. The finding in this analysis that only those who reported the highest number of daily snack items were more likely to follow the Western diet pattern may support the idea that light to moderate snacking is not unhealthy in itself. There may be an optimal number of daily snacks for good health provided these snacks have nutritive value. An FFQ given to 6000 Swiss adults found no association between snacking frequency and BMI, and found three subgroups of high-volume snackers (healthy, moderate and unhealthy). The unhealthy snacking group was more likely to include high alcohol consumption and daily breakfast skipping. Women made healthier food choices and were more likely to have fruit as snacks, and men were more likely to choose

unhealthy snacks such as sweets and savouries. [136] This may indicate that further research on the content of snack items, and not just their number, may be warranted in this NHANES cohort.

Diet Screening: Short Form FFQs Incorporating Dietary Habit Data

The relationship between unhealthy eating patterns and disease is well established, and determining the likelihood that an individual follows an unhealthy pattern without administering a complete FFQ is potentially useful for situations in which time or resources for screening are limited. [137, 138] An updated or short form FFQ that captures the nuances of how people eat may better identify individuals at risk for disease[45, 139]. [137] Short screeners based on full FFQs have been used in primary care settings to screen for cardiometabolic risk factors. A higher score on a short form diet quality index tested on over 2000 men and women was positively correlated with HDL and negatively correlated with waist circumference and total cholesterol at 10 year followup [140]. A short-form FFQ also presents less burden for the respondent and may improve response and completion rates. A brief scale might incorporate results from analyses such as this one by including questions about how many times a week a respondent skips breakfast, how many snacking occasions they have each day, how often they eat out, or whether they have eaten any fruits or vegetables on the day of recall as a means of determining how an individual would be likely to score on a long form FFQ.

To date no FFQs based on eating habits have been widely used in US populations, although there have been some meal-based FFQ formats tested in small-scale studies. An FFQ that is intuitive and asks about food items in the context that they are eaten rather than as a long list of food frequencies may mitigate problems with recall and improve the quality of data collected. The FFQ used for NHANES asks respondents about the frequency of consumption for individual food items. An FFQ designed in a meal-based format that includes dietary habits may be better able to capture food items in the context that they were eaten and may be more intuitive for respondents. The most popular FFQs in use today, including the one used in NHANES, organize foods in categories including dairy, fruits, vegetables, eggs, meat, fish, cereals, breads and starches, beverages, and sweets, with frequency information collected for each item. Each food item is given its own question within a category, generally in isolation from other foods that may be commonly associated with that item. Questions on additions to food are asked next to a particular food item, but food items commonly found together in the same meal are not listed next to each other. 24-hour recall data collection does allow for respondents to group food items in a more intuitive way, and integration of data from both sources is potentially important to understanding overall diet patterns. In a pilot study, Subar [32] found a strong respondent preference for collecting 24-hour dietary recall data in a meal-based format rather than by food categories, suggesting that a meal-based format may reduce respondent burden.

Organizing an FFQ around meals and dietary habits may better capture temporal and situational variation in eating patterns and put the respondent in a “meal mindset” where they can more clearly recall what they typically eat in certain situations. Asking questions in the context of the respondent's daily routine, keeping in mind weekly (and less frequent) variations in that routine, should allow for better recall of deviations from the respondent's normal diet, and more accurate capture of between-person differences in the dietary profile. Because the primary goal of both the meal-based FFQ that includes questions on dietary habits and the scales determined by FFQ factor analysis is to determine dietary patterns and not absolute nutrient intake, a validation study would be necessary to determine the extent to which these methods capture the various meal combinations listed in diet records and any variability between individuals in reporting various meal types.

Studies in other countries have found good agreement between meal-based and traditional FFQ results, which may indicate that a similar approach could be useful in US dietary studies [22, 141-143]. Kim [142] developed a meal-based FFQ for use in Korean populations based on the most commonly eaten dishes and individual food items reported in the Korean National Health and Nutrition Examination Survey (KNHANES), finding 95 items (of the original 993 dishes and foods from KNHANES data) that accounted for 90% of subjects' nutrient intake, and 99% of the between-person variation for the 17 nutrients of interest (the 17 nutrients consumed in the highest amounts based on the national sample). This FFQ was designed to capture the traditional dishes of the Korean

diet, and incorporate items such as sauces and spices not included in FFQs where food is listed by category. There is also evidence to suggest that altering the format of an FFQ can affect the accuracy of the data obtained from it, so FFQ redesign should be approached cautiously [22]. For example, a study of several FFQ formats among 6783 Swedish women [144] found that changing item response options so that frequency was asked in descending order increased intake estimates by 3 to 11 percent.

The ability to classify respondents into likely strong adherents of the Western and prudent dietary patterns could have value due to other known associations with these patterns. For example, Lohse et al. [145] found the healthy and Western patterns in a sample of 149 women who were either current or past participants in the Supplemental Nutrition Assistance Program (SNAP). Followers of the healthy diet pattern tended to have what the authors referred to as "eating competency," an index which encompasses domains of eating attitudes, food acceptance, internal regulation of food intake and eating context. Individuals with high eating competency tend to be knowledgeable of how to shop for and prepare meals, enjoy eating healthy foods, and be accepting of adding new foods to their diet. [146]

Strengths and Limitations

The data in NHANES from a single cohort represent a snapshot of the dietary status of a sample of the US population. This makes it possible to determine associations, but not causes. The NHANES sample was created using sample weights to account for underrepresented groups. Odds ratios resulting from final logistic models constructed both with and without sample weights were similar.

Errors due to respondent recall in FFQs may result from the difficulty of remembering intake over long periods, and both under and over-reporting of certain foods based on social desirability are common in epidemiologic studies [21, 31, 141, 147, 148]. Energy intake is typically under-reported in FFQs[68], and under-reporting may be more common among obese individuals.[90] The accuracy of data collected from FFQs may also be limited by how some questions are asked; for example in the FFQ developed by Block, many respondents may not know exactly how many ounces of meat they consumed for a particular meal [149]. FFQs may also lack sufficient detail about regional and ethnic foods, spices, or sauces that may contribute greatly to a respondent's nutritional profile. Underreporting can also be an issue with 24-hour dietary recall, and in addition to obesity may also be correlated with age, gender, social desirability, and education level. [150] In a review of dietary surveys looking at the effect of over and under-reporting, Willett (1998) found that excluding individuals reporting low energy intake, or controlling for energy intake, did not affect dietary composition or nutrient profiles, stating that "while underreporting of

total energy intake is an important issue in some circumstances, it is not a major issue in epidemiologic analyses because dietary composition is the primary focus; moreover, the major correlates of underreporting such as age, gender and body fat are accounted for in typical analyses." [35]

In the process of asking respondents to distill their entire weekly or monthly dietary experience on a per-item basis, FFQs ask respondents to accurately recall eating behaviors across a wide range of situations, including in the home, at others homes, at restaurants, and while traveling. These “episodic” eating occasions is significant because according to some estimates, almost half Americans' food budgets are spent outside the home, and people tend to eat more calories when eating out [33, 63]. There are statistical methods to help estimate the intake of these episodic foods that make up such a substantial portion of the American diet [33, 111, 113], and these methods may also improve the results of factor analysis by including statistically-derived food item variables to represent respondent eating behaviors that are difficult to measure directly. Collection of 24-hour recall data is also prone to missing data from episodic eating occasions. Collecting data from multiple 24-hour periods or using averaging or other statistical techniques may provide a better picture of overall dietary patterns than collecting data from one day, but information about intake on holidays and other special occasions can be missed even with these methods.

One criticism of the factor analysis method is the potential lack of reproducibility of study findings[92]. The choice of which variables to include in a

factor analysis, how to group those variables, and the interpretation of resulting factors can all be informed by previous studies, but these decisions are subjective and can make comparison between studies based on factor analysis difficult. According to McCann[108], the goal of factor analysis is to explain 80-90% of variance in a dataset, yet the average total variance explained by the interpretable factors in a 2001 review of dietary studies was only 37% [109, 151]. This is sometimes explained as a result of the multidimensional nature of diet, with the interpretability of factors being more important than the amount of variance explained[97]. Tseng [147] argues that conducing factor analyses such as these on FFQ data may not be the most useful method for identifying diet patterns, suggesting that "…the greater challenge may be to gain a more complete a priori understanding of dietary patterns before trying to measure them, thus raising the possibility of measuring dietary patterns directly rather than relying on ad hoc interpretations of dietary data." [147] Structural equation modeling and confirmatory factor analysis allows for hypothesis testing of predefined relations between foods, food intake patterns, covariates and an outcome in one model as generated from other studies or from analysis of split samples within the same study.[90]

There are other important covariates not examined in this analysis but warrant future investigation. For example a lower body mass index (BMI) has been shown to be correlated with a healthy pattern in other epidemiologic studies [152, 153], and this relationship should also be examined with the NHANES dataset. Future analyses may also explore the relationship between chronic

disease and health status. This analysis found that in general older adults tended to eat healthier but these findings might be considered in light of the fact that people in older age groups are more likely to have chronic conditions that might affect dietary choices. These findings might also be reviewed in the context of historical trends. Given the changes in government dietary recommendations over the years, older members of the NHANES cohort may habitually consume foods based on older recommendations that may have adverse health effects. For example since their introduction to the food supply at the turn of the 20th century, trans fats (mostly in the form of margarines) increased in popularity. Even when evidence began to emerge that these fats were more deleterious to heart health than saturated fats, the medical and public health establishments did not propose limiting intake of these substances until the late 1980s. Trans fat margarines were even recommended as a healthy alternative to saturated fats. Older Americans growing up in a time when margarines were common in recipes (e.g. Crisco) might still cook with these substances out of habit or preference. [154]

Nutrition Policy and Planning

Policy efforts at all levels are necessary to help manage the obesity problem in the US. At the public health level, results from analyses such as these may be useful for enacting policies that encourage individuals to choose diets richer in nutrients and lower in energy density. Policies affecting agriculture and corporate tax incentives can also achieve impact on a large scale[106]. Encouraging individual behavior change is challenging given the common two-

wage-earner busy lifestyle of many US adults, but there are interventions that show promise. Increasing access to healthy food and addressing the issue of "food deserts" is important, but the food shopping experience for minority groups most vulnerable to chronic disease should be considered. Blitstein et al. [155] demonstrated that characteristics of the shopping context including quality, selection and convenience should be considered in addition to mere access in order to increase fruit and vegetable consumption. Primary care interventions such as distributing fruit and vegetable shopping vouchers have been shown to be effective as a health education and awareness effort, although the effectiveness of such interventions in actually increasing fruit and vegetable consumption may be limited for a short-term intervention. [156] Community-based nutrition education outreach campaigns conducted over several years have shown statistically significant improvements in rates of fruit and vegetable consumption compared to control communities. [157]

One projection put the cost of obesity-related chronic diseases in the US as between 48 and 66 billion dollars per year by 2030 [158]. Even modest improvements in dietary habits can have a large impact on medical expenditures. A model incorporating data from national surveys, peer-reviewed studies, and government reports estimated annual US cost savings of $60 billion annually with a permanent per-person reduction of 100 kcal per day. Authors recommended calorie reduction as the highest priority behavior change goal. [76] Further analyses might also determine if healthy and unhealthy eating patterns differ

based on region of the US, or depend on cultural differences and the availability and popularity of certain foods.

HUMAN SUBJECTS

This was an analysis of publicly available data from the CDC NCHS website. There was no data collection or interaction with human subjects for this analysis. IRB review was obtained from Drexel University at the exempt level, which applies to all research on publicly available datasets.

APPENDIX

NHANES Food Questionnaire

More than one member of your household may have received a questionnaire. Please make sure this is your booklet before answering any questions.

LABEL HERE

3/8" SPIN

GENERAL INSTRUCTIONS

- **Answer each question as best you can. Estimate if you are not sure. A guess is better than leaving a blank.**
- **Use only a No. 2 pencil.**
- **Be certain to completely blacken in each of the answers.**
- **Erase completely if you make any changes.**
- **Do not make any stray marks on this form.**
- **If you blacken NEVER or NO for a question, please follow any arrows or instructions that direct you to the next question.**

PLEASE DO NOT WRITE IN THIS AREA

SERIAL #

Public reporting burden of this collection of information is estimated to be 45 minutes per response for total participation, including time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. An agency may not conduct or sponsor, and a person is not required to respond to collection of information unless it displays a currently valid OMB control number. Send comments regarding this burden estimate or any other aspects of this collection of information, including suggestions for reducing burden to: CDC/ATSDR Reports Clearance Officer, 1800 Clifton Road, MS D-24, Atlanta, GA 30333, Attention: PRA (0920-0237).

1. Over the past 12 months, how often did you drink **tomato juice** or **vegetable juice**?

- ◯ NEVER

- ◯ 1 time per month or less
- ◯ 2–3 times per month
- ◯ 1–2 times per week
- ◯ 3–4 times per week
- ◯ 5–6 times per week
- ◯ 1 time per day
- ◯ 2–3 times per day
- ◯ 4–5 times per day
- ◯ 6 or more times per day

2. How often did you drink **orange juice** or **grapefruit juice?**

- ◯ NEVER

- ◯ 1 time per month or less
- ◯ 2–3 times per month
- ◯ 1–2 times per week
- ◯ 3–4 times per week
- ◯ 5–6 times per week
- ◯ 1 time per day
- ◯ 2–3 times per day
- ◯ 4–5 times per day
- ◯ 6 or more times per day

3. How often did you drink **apple juice?**

- ◯ NEVER

- ◯ 1 time per month or less
- ◯ 2–3 times per month
- ◯ 1–2 times per week
- ◯ 3–4 times per week
- ◯ 5–6 times per week
- ◯ 1 time per day
- ◯ 2–3 times per day
- ◯ 4–5 times per day
- ◯ 6 or more times per day

4. How often did you drink **grape juice?**

- ◯ NEVER

- ◯ 1 time per month or less
- ◯ 2–3 times per month
- ◯ 1–2 times per week
- ◯ 3–4 times per week
- ◯ 5–6 times per week
- ◯ 1 time per day
- ◯ 2–3 times per day
- ◯ 4–5 times per day
- ◯ 6 or more times per day

5. How often did you drink **other 100% fruit juice** or **100% fruit juice mixtures** (such as pineapple, prune, or others)?

- ◯ NEVER

- ◯ 1 time per month or less
- ◯ 2–3 times per month
- ◯ 1–2 times per week
- ◯ 3–4 times per week
- ◯ 5–6 times per week
- ◯ 1 time per day
- ◯ 2–3 times per day
- ◯ 4–5 times per day
- ◯ 6 or more times per day

6. How often did you drink other **fruit drinks** (such as cranberry cocktail, Hi-C, lemonade, or Kool-Aid, diet or regular)?

- ◯ NEVER **(GO TO QUESTION 7)**

- ◯ 1 time per month or less
- ◯ 2–3 times per month
- ◯ 1–2 times per week
- ◯ 3–4 times per week
- ◯ 5–6 times per week
- ◯ 1 time per day
- ◯ 2–3 times per day
- ◯ 4–5 times per day
- ◯ 6 or more times per day

6a. How often were your fruit drinks **diet** or **sugar-free drinks**?

- ◯ Almost never or never
- ◯ About 1/4 of the time
- ◯ About 1/2 of the time
- ◯ About 3/4 of the time
- ◯ Almost always or always

7. How often did you drink **milk as a beverage** (NOT in coffee, NOT in cereal)? (Please include chocolate milk and hot chocolate.)

- ◯ NEVER **(GO TO QUESTION 8)**

- ◯ 1 time per month or less
- ◯ 2–3 times per month
- ◯ 1–2 times per week
- ◯ 3–4 times per week
- ◯ 5–6 times per week
- ◯ 1 time per day
- ◯ 2–3 times per day
- ◯ 4–5 times per day
- ◯ 6 or more times per day

7a. What kind of **milk** did you usually drink?

- ◯ Whole milk
- ◯ 2% fat milk
- ◯ 1% fat milk
- ◯ Skim, nonfat, or 1/2% fat milk
- ◯ Soy milk
- ◯ Rice milk
- ◯ Raw, unpasteurized milk
- ◯ Other

BAR CODE LABEL HERE

Question 8 appears on the next page.

Over the past 12 months...

8. How often did you drink **meal replacement, energy, or high-protein beverages** such as Instant Breakfast, Ensure, Slimfast, Sustacal or others?

- ◯ NEVER
- ◯ 1 time per month or less
- ◯ 2–3 times per month
- ◯ 1–2 times per week
- ◯ 3–4 times per week
- ◯ 5–6 times per week
- ◯ 1 time per day
- ◯ 2–3 times per day
- ◯ 4–5 times per day
- ◯ 6 or more times per day

9. Over the past 12 months, did you drink **soft drinks, soda,** or **pop**?

- ◯ NO **(GO TO QUESTION 10)**
- ◯ YES

9a. How often did you drink **soft drinks, soda,** or **pop IN THE SUMMER**?

- ◯ NEVER
- ◯ 1 time per month or less
- ◯ 2–3 times per month
- ◯ 1–2 times per week
- ◯ 3–4 times per week
- ◯ 5–6 times per week
- ◯ 1 time per day
- ◯ 2–3 times per day
- ◯ 4–5 times per day
- ◯ 6 or more times per day

9b. How often did you drink **soft drinks, soda,** or **pop DURING THE REST OF THE YEAR**?

- ◯ NEVER
- ◯ 1 time per month or less
- ◯ 2–3 times per month
- ◯ 1–2 times per week
- ◯ 3–4 times per week
- ◯ 5–6 times per week
- ◯ 1 time per day
- ◯ 2–3 times per day
- ◯ 4–5 times per day
- ◯ 6 or more times per day

9c. How often were these soft drinks, soda, or pop **diet** or **sugar-free**?

- ◯ Almost never or never
- ◯ About 1/4 of the time
- ◯ About 1/2 of the time
- ◯ About 3/4 of the time
- ◯ Almost always or always

9d. How often were these soft drinks, soda, or pop **caffeine-free**?

- ◯ Almost never or never
- ◯ About 1/4 of the time
- ◯ About 1/2 of the time
- ◯ About 3/4 of the time
- ◯ Almost always or always

Question 10 appears in the next column.

10. Over the past 12 months, did you drink **beer**?

- ◯ NO **(GO TO QUESTION 11)**
- ◯ YES

10a. How often did you drink **beer IN THE SUMMER**?

- ◯ NEVER
- ◯ 1 time per month or less
- ◯ 2–3 times per month
- ◯ 1–2 times per week
- ◯ 3–4 times per week
- ◯ 5–6 times per week
- ◯ 1 time per day
- ◯ 2–3 times per day
- ◯ 4–5 times per day
- ◯ 6 or more times per day

10b. How often did you drink **beer DURING THE REST OF THE YEAR**?

- ◯ NEVER
- ◯ 1 time per month or less
- ◯ 2–3 times per month
- ◯ 1–2 times per week
- ◯ 3–4 times per week
- ◯ 5–6 times per week
- ◯ 1 time per day
- ◯ 2–3 times per day
- ◯ 4–5 times per day
- ◯ 6 or more times per day

11. How often did you drink **wine** or **wine coolers**?

- ◯ NEVER
- ◯ 1 time per month or less
- ◯ 2–3 times per month
- ◯ 1–2 times per week
- ◯ 3–4 times per week
- ◯ 5–6 times per week
- ◯ 1 time per day
- ◯ 2–3 times per day
- ◯ 4–5 times per day
- ◯ 6 or more times per day

12. How often did you drink **liquor** or **mixed drinks**?

- ◯ NEVER
- ◯ 1 time per month or less
- ◯ 2–3 times per month
- ◯ 1–2 times per week
- ◯ 3–4 times per week
- ◯ 5–6 times per week
- ◯ 1 time per day
- ◯ 2–3 times per day
- ◯ 4–5 times per day
- ◯ 6 or more times per day

Over the past 12 months...

13. Did you eat **oatmeal, grits,** or **other cooked cereal?**

- ◯ NO **(GO TO QUESTION 14)**
- ◯ YES

13a. How often did you eat **oatmeal, grits,** or **other cooked cereal IN THE WINTER**?

- ◯ NEVER
- ◯ 1–6 times per winter
- ◯ 7–11 times per winter
- ◯ 1 time per month
- ◯ 2–3 times per month
- ◯ 1 time per week
- ◯ 2 times per week
- ◯ 3–4 times per week
- ◯ 5–6 times per week
- ◯ 1 time per day
- ◯ 2 or more times per day

13b. How often did you eat **oatmeal, grits,** or **other cooked cereal DURING THE REST OF THE YEAR?**

- ◯ NEVER
- ◯ 1–6 times per year
- ◯ 7–11 times per year
- ◯ 1 time per month
- ◯ 2–3 times per month
- ◯ 1 time per week
- ◯ 2 times per week
- ◯ 3–4 times per week
- ◯ 5–6 times per week
- ◯ 1 time per day
- ◯ 2 or more times per day

13c. How often was the cooked cereal you ate **oatmeal**?

- ◯ Almost never or never
- ◯ About 1/4 of the time
- ◯ About 1/2 of the time
- ◯ About 3/4 of the time
- ◯ Almost always or always

14. How often did you eat **cold cereal**?

- ◯ NEVER **(GO TO QUESTION 15)**
- ◯ 1–6 times per year
- ◯ 7–11 times per year
- ◯ 1 time per month
- ◯ 2–3 times per month
- ◯ 1 time per week
- ◯ 2 times per week
- ◯ 3–4 times per week
- ◯ 5–6 times per week
- ◯ 1 time per day
- ◯ 2 or more times per day

Question 15 appears in the next column.

14a. How often was the cold cereal you ate a **whole grain type** (such as shredded wheat, Wheaties, Cheerios, Raisin Bran or other bran, oat, or whole wheat cereal)?

- ◯ Almost never or never
- ◯ About 1/4 of the time
- ◯ About 1/2 of the time
- ◯ About 3/4 of the time
- ◯ Almost always or always

14b. Was **milk** added to your cold cereal?

- ◯ NO **(GO TO QUESTION 15)**
- ◯ YES

14c. What kind of **milk** was usually added?

- ◯ Whole milk
- ◯ 2% fat milk
- ◯ 1% fat milk
- ◯ Skim, nonfat, or 1/2% fat milk
- ◯ Soy milk
- ◯ Rice milk
- ◯ Raw, unpasteurized milk
- ◯ Other

15. How often did you eat **applesauce**?

- ◯ NEVER
- ◯ 1–6 times per year
- ◯ 7–11 times per year
- ◯ 1 time per month
- ◯ 2–3 times per month
- ◯ 1 time per week
- ◯ 2 times per week
- ◯ 3–4 times per week
- ◯ 5–6 times per week
- ◯ 1 time per day
- ◯ 2 or more times per day

16. How often did you eat **apples**?

- ◯ NEVER
- ◯ 1–6 times per year
- ◯ 7–11 times per year
- ◯ 1 time per month
- ◯ 2–3 times per month
- ◯ 1 time per week
- ◯ 2 times per week
- ◯ 3–4 times per week
- ◯ 5–6 times per week
- ◯ 1 time per day
- ◯ 2 or more times per day

17. How often did you eat **pears** (fresh, canned, or frozen)?

- ◯ NEVER
- ◯ 1–6 times per year
- ◯ 7–11 times per year
- ◯ 1 time per month
- ◯ 2–3 times per month
- ◯ 1 time per week
- ◯ 2 times per week
- ◯ 3–4 times per week
- ◯ 5–6 times per week
- ◯ 1 time per day
- ◯ 2 or more times per day

Over the past 12 months...

18. How often did you eat **bananas** ?

- ◯ NEVER
- ◯ 1–6 times per year
- ◯ 7–11 times per year
- ◯ 1 time per month
- ◯ 2–3 times per month
- ◯ 1 time per week
- ◯ 2 times per week
- ◯ 3–4 times per week
- ◯ 5–6 times per week
- ◯ 1 time per day
- ◯ 2 or more times per day

19. How often did you eat **pineapple**?

- ◯ NEVER
- ◯ 1–6 times per year
- ◯ 7–11 times per year
- ◯ 1 time per month
- ◯ 2–3 times per month
- ◯ 1 time per week
- ◯ 2 times per week
- ◯ 3–4 times per week
- ◯ 5–6 times per week
- ◯ 1 time per day
- ◯ 2 or more times per day

20. How often did you eat **dried fruit**, such as prunes or raisins?

- ◯ NEVER
- ◯ 1–6 times per year
- ◯ 7–11 times per year
- ◯ 1 time per month
- ◯ 2–3 times per month
- ◯ 1 time per week
- ◯ 2 times per week
- ◯ 3–4 times per week
- ◯ 5–6 times per week
- ◯ 1 time per day
- ◯ 2 or more times per day

21. Over the past 12 months, did you eat **peaches, nectarines,** or **plums**?

- ◯ NO **(GO TO QUESTION 22)**
- ◯ YES

21a. How often did you eat **fresh peaches, nectarines**, or **plums WHEN IN SEASON**?

- ◯ NEVER
- ◯ 1–6 times per season
- ◯ 7–11 times per season
- ◯ 1 time per month
- ◯ 2–3 times per month
- ◯ 1 time per week
- ◯ 2 times per week
- ◯ 3–4 times per week
- ◯ 5–6 times per week
- ◯ 1 time per day
- ◯ 2 or more times per day

Question 22 appears in the next column.

21b. How often did you eat **peaches, nectarines,** or **plums** (fresh, canned, or frozen) **DURING THE REST OF THE YEAR**?

- ◯ NEVER
- ◯ 1–6 times per year
- ◯ 7–11 times per year
- ◯ 1 time per month
- ◯ 2–3 times per month
- ◯ 1 time per week
- ◯ 2 times per week
- ◯ 3–4 times per week
- ◯ 5–6 times per week
- ◯ 1 time per day
- ◯ 2 or more times per day

22. How often did you eat **grapes**?

- ◯ NEVER
- ◯ 1–6 times per year
- ◯ 7–11 times per year
- ◯ 1 time per month
- ◯ 2–3 times per month
- ◯ 1 time per week
- ◯ 2 times per week
- ◯ 3–4 times per week
- ◯ 5–6 times per week
- ◯ 1 time per day
- ◯ 2 or more times per day

23. Over the past 12 months, did you eat **melons** (such as cantaloupe, watermelon, or honeydew)?

- ◯ NO **(GO TO QUESTION 24)**
- ◯ YES

23a. How often did you eat **fresh melons** (such as cantaloupe, watermelon, or honeydew) **WHEN IN SEASON**?

- ◯ NEVER
- ◯ 1–6 times per season
- ◯ 7–11 times per season
- ◯ 1 time per month
- ◯ 2–3 times per month
- ◯ 1 time per week
- ◯ 2 times per week
- ◯ 3–4 times per week
- ◯ 5–6 times per week
- ◯ 1 time per day
- ◯ 2 or more times per day

23b. How often did you eat **fresh or frozen melons** (such as cantaloupe, watermelon, or honeydew) **DURING THE REST OF THE YEAR**?

- ◯ NEVER
- ◯ 1–6 times per year
- ◯ 7–11 times per year
- ◯ 1 time per month
- ◯ 2–3 times per month
- ◯ 1 time per week
- ◯ 2 times per week
- ◯ 3–4 times per week
- ◯ 5–6 times per week
- ◯ 1 time per day
- ◯ 2 or more times per day

Question 24 appears on the next page.

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Over the past 12 months...

24. Did you eat **strawberries**?

- ◯ NO **(GO TO QUESTION 25)**
- ◯ YES

24a. How often did you eat **fresh strawberries WHEN IN SEASON**?

- ◯ NEVER
- ◯ 1–6 times per season
- ◯ 7–11 times per season
- ◯ 1 time per month
- ◯ 2–3 times per month
- ◯ 1 time per week
- ◯ 2 times per week
- ◯ 3–4 times per week
- ◯ 5–6 times per week
- ◯ 1 time per day
- ◯ 2 or more times per day

24b. How often did you eat **fresh** or **frozen strawberries DURING THE REST OF THE YEAR**?

- ◯ NEVER
- ◯ 1–6 times per year
- ◯ 7–11 times per year
- ◯ 1 time per month
- ◯ 2–3 times per month
- ◯ 1 time per week
- ◯ 2 times per week
- ◯ 3–4 times per week
- ◯ 5–6 times per week
- ◯ 1 time per day
- ◯ 2 or more times per day

25. Over the past 12 months, did you eat **oranges, tangerines, clementines,** or **tangelos**?

- ◯ NO **(GO TO QUESTION 26)**
- ◯ YES

25a. How often did you eat **fresh oranges, tangerines, clementines,** or **tangelos WHEN IN SEASON**?

- ◯ NEVER
- ◯ 1–6 times per season
- ◯ 7–11 times per season
- ◯ 1 time per month
- ◯ 2–3 times per month
- ◯ 1 time per week
- ◯ 2 times per week
- ◯ 3–4 times per week
- ◯ 5–6 times per week
- ◯ 1 time per day
- ◯ 2 or more times per day

Question 26 appears in the next column.

25b. How often did you eat **oranges, tangerines, clementines,** or **tangelos** (fresh or canned) **DURING THE REST OF THE YEAR**?

- ◯ NEVER
- ◯ 1–6 times per year
- ◯ 7–11 times per year
- ◯ 1 time per month
- ◯ 2–3 times per month
- ◯ 1 time per week
- ◯ 2 times per week
- ◯ 3–4 times per week
- ◯ 5–6 times per week
- ◯ 1 time per day
- ◯ 2 or more times per day

26. Over the past 12 months, did you eat **grapefruit**?

- ◯ NO **(GO TO QUESTION 27)**
- ◯ YES

26a. How often did you eat **fresh grapefruit WHEN IN SEASON**?

- ◯ NEVER
- ◯ 1–6 times per season
- ◯ 7–11 times per season
- ◯ 1 time per month
- ◯ 2–3 times per month
- ◯ 1 time per week
- ◯ 2 times per week
- ◯ 3–4 times per week
- ◯ 5–6 times per week
- ◯ 1 time per day
- ◯ 2 or more times per day

26b. How often did you eat **grapefruit** (fresh or canned) **DURING THE REST OF THE YEAR?**

- ◯ NEVER
- ◯ 1–6 times per year
- ◯ 7–11 times per year
- ◯ 1 time per month
- ◯ 2–3 times per month
- ◯ 1 time per week
- ◯ 2 times per week
- ◯ 3–4 times per week
- ◯ 5–6 times per week
- ◯ 1 time per day
- ◯ 2 or more times per day

27. How often did you eat **other kinds of fruit**?

- ◯ NEVER
- ◯ 1–6 times per year
- ◯ 7–11 times per year
- ◯ 1 time per month
- ◯ 2–3 times per month
- ◯ 1 time per week
- ◯ 2 times per week
- ◯ 3–4 times per week
- ◯ 5–6 times per week
- ◯ 1 time per day
- ◯ 2 or more times per day

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Over the past 12 months...

28. How often did you eat **COOKED greens** (such as spinach, turnip, collard, mustard, chard, or kale)?

- ◯ NEVER
- ◯ 1–6 times per year
- ◯ 7–11 times per year
- ◯ 1 time per month
- ◯ 2–3 times per month
- ◯ 1 time per week
- ◯ 2 times per week
- ◯ 3–4 times per week
- ◯ 5–6 times per week
- ◯ 1 time per day
- ◯ 2 or more times per day

29. How often did you eat **RAW greens** (such as spinach, turnip, collard, mustard, chard, or kale)? *(We will ask about lettuce later.)*

- ◯ NEVER
- ◯ 1–6 times per year
- ◯ 7–11 times per year
- ◯ 1 time per month
- ◯ 2–3 times per month
- ◯ 1 time per week
- ◯ 2 times per week
- ◯ 3–4 times per week
- ◯ 5–6 times per week
- ◯ 1 time per day
- ◯ 2 or more times per day

30. How often did you eat **coleslaw**?

- ◯ NEVER
- ◯ 1–6 times per year
- ◯ 7–11 times per year
- ◯ 1 time per month
- ◯ 2–3 times per month
- ◯ 1 time per week
- ◯ 2 times per week
- ◯ 3–4 times per week
- ◯ 5–6 times per week
- ◯ 1 time per day
- ◯ 2 or more times per day

31. How often did you eat **sauerkraut** or **cabbage** (other than coleslaw)?

- ◯ NEVER
- ◯ 1–6 times per year
- ◯ 7–11 times per year
- ◯ 1 time per month
- ◯ 2–3 times per month
- ◯ 1 time per week
- ◯ 2 times per week
- ◯ 3–4 times per week
- ◯ 5–6 times per week
- ◯ 1 time per day
- ◯ 2 or more times per day

32. How often did you eat **carrots** (fresh, canned, or frozen)?

- ◯ NEVER
- ◯ 1–6 times per year
- ◯ 7–11 times per year
- ◯ 1 time per month
- ◯ 2–3 times per month
- ◯ 1 time per week
- ◯ 2 times per week
- ◯ 3–4 times per week
- ◯ 5–6 times per week
- ◯ 1 time per day
- ◯ 2 or more times per day

33. How often did you eat **string beans** or **green beans** (fresh, canned, or frozen)?

- ◯ NEVER
- ◯ 1–6 times per year
- ◯ 7–11 times per year
- ◯ 1 time per month
- ◯ 2–3 times per month
- ◯ 1 time per week
- ◯ 2 times per week
- ◯ 3–4 times per week
- ◯ 5–6 times per week
- ◯ 1 time per day
- ◯ 2 or more times per day

34. How often did you eat **peas** (fresh, canned, or frozen)?

- ◯ NEVER
- ◯ 1–6 times per year
- ◯ 7–11 times per year
- ◯ 1 time per month
- ◯ 2–3 times per month
- ◯ 1 time per week
- ◯ 2 times per week
- ◯ 3–4 times per week
- ◯ 5–6 times per week
- ◯ 1 time per day
- ◯ 2 or more times per day

35. Over the past 12 months, did you eat **corn**?

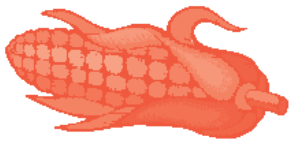
- ◯ NO **(GO TO QUESTION 36)**
- ◯ YES

35a. How often did you eat **corn** (fresh, canned, or frozen) **WHEN IN SEASON**?

- ◯ NEVER
- ◯ 1–6 times per season
- ◯ 7–11 times per season
- ◯ 1 time per month
- ◯ 2–3 times per month
- ◯ 1 time per week
- ◯ 2 times per week
- ◯ 3–4 times per week
- ◯ 5–6 times per week
- ◯ 1 time per day
- ◯ 2 or more times per day

35b. How often did you eat **corn** (fresh, canned, or frozen) **DURING THE REST OF THE YEAR**?

- ◯ NEVER
- ◯ 1–6 times per year
- ◯ 7–11 times per year
- ◯ 1 time per month
- ◯ 2–3 times per month
- ◯ 1 time per week
- ◯ 2 times per week
- ◯ 3–4 times per week
- ◯ 5–6 times per week
- ◯ 1 time per day
- ◯ 2 or more times per day



Question 36 appears on the next page.

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Over the past 12 months...

36. How often did you eat **broccoli** (fresh or frozen)?

- ◯ NEVER

- ◯ 1–6 times per year
- ◯ 7–11 times per year
- ◯ 1 time per month
- ◯ 2–3 times per month
- ◯ 1 time per week
- ◯ 2 times per week
- ◯ 3–4 times per week
- ◯ 5–6 times per week
- ◯ 1 time per day
- ◯ 2 or more times per day

37. How often did you eat **cauliflower** or **Brussels sprouts** (fresh or frozen)?

- ◯ NEVER

- ◯ 1–6 times per year
- ◯ 7–11 times per year
- ◯ 1 time per month
- ◯ 2–3 times per month
- ◯ 1 time per week
- ◯ 2 times per week
- ◯ 3–4 times per week
- ◯ 5–6 times per week
- ◯ 1 time per day
- ◯ 2 or more times per day

38. How often did you eat **mixed vegetables**?

- ◯ NEVER

- ◯ 1–6 times per year
- ◯ 7–11 times per year
- ◯ 1 time per month
- ◯ 2–3 times per month
- ◯ 1 time per week
- ◯ 2 times per week
- ◯ 3–4 times per week
- ◯ 5–6 times per week
- ◯ 1 time per day
- ◯ 2 or more times per day

39. How often did you eat **onions** (including in mixtures)?

- ◯ NEVER

- ◯ 1–6 times per year
- ◯ 7–11 times per year
- ◯ 1 time per month
- ◯ 2–3 times per month
- ◯ 1 time per week
- ◯ 2 times per week
- ◯ 3–4 times per week
- ◯ 5–6 times per week
- ◯ 1 time per day
- ◯ 2 or more times per day

40. Over the past 12 months, how often did you eat **sweet or hot peppers** (green, red, or yellow)?

- ◯ NEVER

- ◯ 1–6 times per year
- ◯ 7–11 times per year
- ◯ 1 time per month
- ◯ 2–3 times per month
- ◯ 1 time per week
- ◯ 2 times per week
- ◯ 3–4 times per week
- ◯ 5–6 times per week
- ◯ 1 time per day
- ◯ 2 or more times per day

41. How often did you eat **raw cucumbers** (not including pickles)?

- ◯ NEVER

- ◯ 1–6 times per year
- ◯ 7–11 times per year
- ◯ 1 time per month
- ◯ 2–3 times per month
- ◯ 1 time per week
- ◯ 2 times per week
- ◯ 3–4 times per week
- ◯ 5–6 times per week
- ◯ 1 time per day
- ◯ 2 or more times per day

42. Over the past 12 months, did you eat **fresh tomatoes** (including those in salads)?

- ◯ NO **(GO TO QUESTION 43)**
- ◯ YES

42a. How often did you eat **fresh tomatoes** (including those in salads) **WHEN IN SEASON**?

- ◯ NEVER

- ◯ 1–6 times per season
- ◯ 7–11 times per season
- ◯ 1 time per month
- ◯ 2–3 times per month
- ◯ 1 time per week
- ◯ 2 times per week
- ◯ 3–4 times per week
- ◯ 5–6 times per week
- ◯ 1 time per day
- ◯ 2 or more times per day

42b. How often did you eat **fresh tomatoes** (including those in salads) **DURING THE REST OF THE YEAR**?

- ◯ NEVER

- ◯ 1–6 times per year
- ◯ 7–11 times per year
- ◯ 1 time per month
- ◯ 2–3 times per month
- ◯ 1 time per week
- ◯ 2 times per week
- ◯ 3–4 times per week
- ◯ 5–6 times per week
- ◯ 1 time per day
- ◯ 2 or more times per day

Question 43 appears on the next page.

Over the past 12 months...

43. Did you eat **summer squash** (include yellow and green squash)?

- ○ NO **(GO TO QUESTION 44)**
- ○ YES

43a. How often did you eat **summer squash WHEN IN SEASON** (include yellow and green squash)?

- ○ NEVER
- ○ 1–6 times per season
- ○ 7–11 times per season
- ○ 1 time per month
- ○ 2–3 times per month
- ○ 1 time per week
- ○ 2 times per week
- ○ 3–4 times per week
- ○ 5–6 times per week
- ○ 1 time per day
- ○ 2 or more times per day

43b. How often did you eat **summer squash DURING THE REST OF THE YEAR** (include yellow and green squash)?

- ○ NEVER
- ○ 1–6 times per year
- ○ 7–11 times per year
- ○ 1 time per month
- ○ 2–3 times per month
- ○ 1 time per week
- ○ 2 times per week
- ○ 3–4 times per week
- ○ 5–6 times per week
- ○ 1 time per day
- ○ 2 or more times per day

44. How often did you eat **lettuce salads** (with or without other vegetables)?

- ○ NEVER **(GO TO QUESTION 45)**
- ○ 1–6 times per year
- ○ 7–11 times per year
- ○ 1 time per month
- ○ 2–3 times per month
- ○ 1 time per week
- ○ 2 times per week
- ○ 3–4 times per week
- ○ 5–6 times per week
- ○ 1 time per day
- ○ 2 or more times per day

44a. How often were the lettuce salads you ate made with **dark green leaves**?

- ○ Almost never or never
- ○ About 1/4 of the time
- ○ About 1/2 of the time
- ○ About 3/4 of the time
- ○ Almost always or always

Question 45 appears in the next column.

45. How often did you eat **salad dressing** (including low-fat) on salads or other vegetables?

- ○ NEVER
- ○ 1–6 times per year
- ○ 7–11 times per year
- ○ 1 time per month
- ○ 2–3 times per month
- ○ 1 time per week
- ○ 2 times per week
- ○ 3–4 times per week
- ○ 5–6 times per week
- ○ 1 time per day
- ○ 2 or more times per day

46. How often did you eat **sweet potatoes** or **yams**?

- ○ NEVER
- ○ 1–6 times per year
- ○ 7–11 times per year
- ○ 1 time per month
- ○ 2–3 times per month
- ○ 1 time per week
- ○ 2 times per week
- ○ 3–4 times per week
- ○ 5–6 times per week
- ○ 1 time per day
- ○ 2 or more times per day

47. How often did you eat **French fries, home fries, hash browned potatoes**, or **tater tots**?

- ○ NEVER
- ○ 1–6 times per year
- ○ 7–11 times per year
- ○ 1 time per month
- ○ 2–3 times per month
- ○ 1 time per week
- ○ 2 times per week
- ○ 3–4 times per week
- ○ 5–6 times per week
- ○ 1 time per day
- ○ 2 or more times per day

48. How often did you eat **potato salad**?

- ○ NEVER
- ○ 1–6 times per year
- ○ 7–11 times per year
- ○ 1 time per month
- ○ 2–3 times per month
- ○ 1 time per week
- ○ 2 times per week
- ○ 3–4 times per week
- ○ 5–6 times per week
- ○ 1 time per day
- ○ 2 or more times per day

49. How often did you eat **baked, boiled,** or **mashed potatoes**?

- ○ NEVER
- ○ 1–6 times per year
- ○ 7–11 times per year
- ○ 1 time per month
- ○ 2–3 times per month
- ○ 1 time per week
- ○ 2 times per week
- ○ 3–4 times per week
- ○ 5–6 times per week
- ○ 1 time per day
- ○ 2 or more times per day

Over the past 12 months...

50. How often did you eat **salsa**?

- ◯ NEVER

- ◯ 1–6 times per year
- ◯ 7–11 times per year
- ◯ 1 time per month
- ◯ 2–3 times per month
- ◯ 1 time per week
- ◯ 2 times per week
- ◯ 3–4 times per week
- ◯ 5–6 times per week
- ◯ 1 time per day
- ◯ 2 or more times per day

51. How often did you eat **catsup**?

- ◯ NEVER

- ◯ 1–6 times per year
- ◯ 7–11 times per year
- ◯ 1 time per month
- ◯ 2–3 times per month
- ◯ 1 time per week
- ◯ 2 times per week
- ◯ 3–4 times per week
- ◯ 5–6 times per week
- ◯ 1 time per day
- ◯ 2 or more times per day

52. How often did you eat **pickles** or **pickled vegetables**?

- ◯ NEVER

- ◯ 1–6 times per year
- ◯ 7–11 times per year
- ◯ 1 time per month
- ◯ 2–3 times per month
- ◯ 1 time per week
- ◯ 2 times per week
- ◯ 3–4 times per week
- ◯ 5–6 times per week
- ◯ 1 time per day
- ◯ 2 or more times per day

53. How often did you eat **stuffing, dressing,** or **dumplings**?

- ◯ NEVER

- ◯ 1–6 times per year
- ◯ 7–11 times per year
- ◯ 1 time per month
- ◯ 2–3 times per month
- ◯ 1 time per week
- ◯ 2 times per week
- ◯ 3–4 times per week
- ◯ 5–6 times per week
- ◯ 1 time per day
- ◯ 2 or more times per day

54. How often did you eat **chili**?

- ◯ NEVER

- ◯ 1–6 times per year
- ◯ 7–11 times per year
- ◯ 1 time per month
- ◯ 2–3 times per month
- ◯ 1 time per week
- ◯ 2 times per week
- ◯ 3–4 times per week
- ◯ 5–6 times per week
- ◯ 1 time per day
- ◯ 2 or more times per day

55. How often did you eat **tortillas** or **tacos**?

- ◯ NEVER **(GO TO QUESTION 56)**

- ◯ 1–6 times per year
- ◯ 7–11 times per year
- ◯ 1 time per month
- ◯ 2–3 times per month
- ◯ 1 time per week
- ◯ 2 times per week
- ◯ 3–4 times per week
- ◯ 5–6 times per week
- ◯ 1 time per day
- ◯ 2 or more times per day

55a. How often were your tortillas or tacos **corn tortillas** or **tacos**?

- ◯ Almost never or never
- ◯ About 1/4 of the time
- ◯ About 1/2 of the time
- ◯ About 3/4 of the time
- ◯ Almost always or always

56. How often did you eat **cooked dried beans** (such as baked beans, pintos, kidney, blackeyed peas, lima, lentils, soybeans, or refried beans)? *(Please don't include bean soups or chili.)*

- ◯ NEVER

- ◯ 1–6 times per year
- ◯ 7–11 times per year
- ◯ 1 time per month
- ◯ 2–3 times per month
- ◯ 1 time per week
- ◯ 2 times per week
- ◯ 3–4 times per week
- ◯ 5–6 times per week
- ◯ 1 time per day
- ◯ 2 or more times per day

57. How often did you eat **other kinds of vegetables**?

- ◯ NEVER

- ◯ 1–6 times per year
- ◯ 7–11 times per year
- ◯ 1 time per month
- ◯ 2–3 times per month
- ◯ 1 time per week
- ◯ 2 times per week
- ◯ 3–4 times per week
- ◯ 5–6 times per week
- ◯ 1 time per day
- ◯ 2 or more times per day

58. How often did you eat **rice** or **other cooked grains** (such as bulgur, cracked wheat, or millet)?

- ◯ NEVER **(GO TO QUESTION 59)**

- ◯ 1–6 times per year
- ◯ 7–11 times per year
- ◯ 1 time per month
- ◯ 2–3 times per month
- ◯ 1 time per week
- ◯ 2 times per week
- ◯ 3–4 times per week
- ◯ 5–6 times per week
- ◯ 1 time per day
- ◯ 2 or more times per day

Question 59 appears on the next page.

Over the past 12 months...

58a. How often was the rice or other cooked grains you ate **brown rice, cracked wheat,** or **millet**?

- ◯ Almost never or never
- ◯ About 1/4 of the time
- ◯ About 1/2 of the time
- ◯ About 3/4 of the time
- ◯ Almost always or always

59. How often did you eat **pancakes, waffles,** or **French toast**?

- ◯ NEVER **(GO TO QUESTION 60)**
- ◯ 1–6 times per year
- ◯ 7–11 times per year
- ◯ 1 time per month
- ◯ 2–3 times per month
- ◯ 1 time per week
- ◯ 2 times per week
- ◯ 3–4 times per week
- ◯ 5–6 times per week
- ◯ 1 time per day
- ◯ 2 or more times per day

59a. How often was **syrup** added to your pancakes, waffles, or French toast?

- ◯ Almost never or never
- ◯ About 1/4 of the time
- ◯ About 1/2 of the time
- ◯ About 3/4 of the time
- ◯ Almost always or always

60. How often did you eat **lasagna, stuffed shells, stuffed manicotti, ravioli,** or **tortellini**? *(Please do not include spaghetti or other pasta.)*

- ◯ NEVER
- ◯ 1–6 times per year
- ◯ 7–11 times per year
- ◯ 1 time per month
- ◯ 2–3 times per month
- ◯ 1 time per week
- ◯ 2 times per week
- ◯ 3–4 times per week
- ◯ 5–6 times per week
- ◯ 1 time per day
- ◯ 2 or more times per day

61. How often did you eat **macaroni and cheese**?

- ◯ NEVER
- ◯ 1–6 times per year
- ◯ 7–11 times per year
- ◯ 1 time per month
- ◯ 2–3 times per month
- ◯ 1 time per week
- ◯ 2 times per week
- ◯ 3–4 times per week
- ◯ 5–6 times per week
- ◯ 1 time per day
- ◯ 2 or more times per day

62. How often did you eat **pasta salad** or **macaroni salad**?

- ◯ NEVER
- ◯ 1–6 times per year
- ◯ 7–11 times per year
- ◯ 1 time per month
- ◯ 2–3 times per month
- ◯ 1 time per week
- ◯ 2 times per week
- ◯ 3–4 times per week
- ◯ 5–6 times per week
- ◯ 1 time per day
- ◯ 2 or more times per day

63. Other than the pastas listed in Questions 60, 61, and 62, how often did you eat **pasta, spaghetti,** or **other noodles**?

- ◯ NEVER **(GO TO QUESTION 64)**
- ◯ 1–6 times per year
- ◯ 7–11 times per year
- ◯ 1 time per month
- ◯ 2–3 times per month
- ◯ 1 time per week
- ◯ 2 times per week
- ◯ 3–4 times per week
- ◯ 5–6 times per week
- ◯ 1 time per day
- ◯ 2 or more times per day

63a. How often did you eat your pasta, spaghetti, or other noodles with **tomato sauce** or **spaghetti sauce made WITH meat**?

- ◯ Almost never or never
- ◯ About 1/4 of the time
- ◯ About 1/2 of the time
- ◯ About 3/4 of the time
- ◯ Almost always or always

63b. How often did you eat your pasta, spaghetti, or other noodles with **tomato sauce** or **spaghetti sauce made WITHOUT meat**?

- ◯ Almost never or never
- ◯ About 1/4 of the time
- ◯ About 1/2 of the time
- ◯ About 3/4 of the time
- ◯ Almost always or always

63c. How often did you eat your pasta, spaghetti, or other noodles with **margarine, butter, oil,** or **cream sauce**?

- ◯ Almost never or never
- ◯ About 1/4 of the time
- ◯ About 1/2 of the time
- ◯ About 3/4 of the time
- ◯ Almost always or always

Question 64 appears on the next page.

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Over the past 12 months...

64. How often did you eat **bagels** or **English muffins**?

- ◯ NEVER
- ◯ 1–6 times per year
- ◯ 7–11 times per year
- ◯ 1 time per month
- ◯ 2–3 times per month
- ◯ 1 time per week
- ◯ 2 times per week
- ◯ 3–4 times per week
- ◯ 5–6 times per week
- ◯ 1 time per day
- ◯ 2 or more times per day

The next questions ask about your intake of breads other than bagels or English muffins. First, we will ask about bread you ate as part of sandwiches only. Then we will ask about all other bread you ate.

65. How often did you eat **breads** or **rolls AS PART OF SANDWICHES** (including burger and hot dog rolls)?

- ◯ NEVER **(GO TO QUESTION 66)**
- ◯ 1–6 times per year
- ◯ 7–11 times per year
- ◯ 1 time per month
- ◯ 2–3 times per month
- ◯ 1 time per week
- ◯ 2 times per week
- ◯ 3–4 times per week
- ◯ 5–6 times per week
- ◯ 1 time per day
- ◯ 2 or more times per day

65a. How often were the breads or rolls that you used for your sandwiches **white bread** (including burger and hot dog rolls)?

- ◯ Almost never or never
- ◯ About 1/4 of the time
- ◯ About 1/2 of the time
- ◯ About 3/4 of the time
- ◯ Almost always or always

66. How often did you eat **breads** or **dinner rolls, NOT AS PART OF SANDWICHES**?

- ◯ NEVER **(GO TO QUESTION 67)**
- ◯ 1–6 times per year
- ◯ 7–11 times per year
- ◯ 1 time per month
- ◯ 2–3 times per month
- ◯ 1 time per week
- ◯ 2 times per week
- ◯ 3–4 times per week
- ◯ 5–6 times per week
- ◯ 1 time per day
- ◯ 2 or more times per day

66a. How often were the breads or rolls you ate **white bread**?

- ◯ Almost never or never
- ◯ About 1/4 of the time
- ◯ About 1/2 of the time
- ◯ About 3/4 of the time
- ◯ Almost always or always

Question 67 appears in the next column.

67. How often did you eat **jam, jelly,** or **honey** on bagels, muffins, bread, rolls, or crackers?

- ◯ NEVER
- ◯ 1–6 times per year
- ◯ 7–11 times per year
- ◯ 1 time per month
- ◯ 2–3 times per month
- ◯ 1 time per week
- ◯ 2 times per week
- ◯ 3–4 times per week
- ◯ 5–6 times per week
- ◯ 1 time per day
- ◯ 2 or more times per day

68. How often did you eat **peanut butter** or **other nut butter**?

- ◯ NEVER
- ◯ 1–6 times per year
- ◯ 7–11 times per year
- ◯ 1 time per month
- ◯ 2–3 times per month
- ◯ 1 time per week
- ◯ 2 times per week
- ◯ 3–4 times per week
- ◯ 5–6 times per week
- ◯ 1 time per day
- ◯ 2 or more times per day

69. How often did you eat **roast beef** or **steak IN SANDWICHES**?

- ◯ NEVER
- ◯ 1–6 times per year
- ◯ 7–11 times per year
- ◯ 1 time per month
- ◯ 2–3 times per month
- ◯ 1 time per week
- ◯ 2 times per week
- ◯ 3–4 times per week
- ◯ 5–6 times per week
- ◯ 1 time per day
- ◯ 2 or more times per day

70. How often did you eat **turkey** or **chicken COLD CUTS** (such as loaf, luncheon meat, turkey ham, turkey salami, or turkey pastrami)? (*We will ask about other turkey or chicken later.)*

- ◯ NEVER
- ◯ 1–6 times per year
- ◯ 7–11 times per year
- ◯ 1 time per month
- ◯ 2–3 times per month
- ◯ 1 time per week
- ◯ 2 times per week
- ◯ 3–4 times per week
- ◯ 5–6 times per week
- ◯ 1 time per day
- ◯ 2 or more times per day

71. How often did you eat **luncheon** or **deli-style ham**? *(We will ask about other ham later.)*

- ◯ NEVER **(GO TO QUESTION 72)**
- ◯ 1–6 times per year
- ◯ 7–11 times per year
- ◯ 1 time per month
- ◯ 2–3 times per month
- ◯ 1 time per week
- ◯ 2 times per week
- ◯ 3–4 times per week
- ◯ 5–6 times per week
- ◯ 1 time per day
- ◯ 2 or more times per day

Question 72 appears on the next page.

Over the past 12 months...

71a. How often was the luncheon or deli-style ham you ate **light, low-fat, or fat-free**?

- ◯ Almost never or never
- ◯ About 1/4 of the time
- ◯ About 1/2 of the time
- ◯ About 3/4 of the time
- ◯ Almost always or always

72. How often did you eat **other cold cuts** or **luncheon meats** (such as bologna, salami, corned beef, pastrami, or others, including low-fat)? *(Please do not include ham, turkey, or chicken cold cuts.)*

- ◯ NEVER **(GO TO QUESTION 73)**
- ◯ 1–6 times per year
- ◯ 7–11 times per year
- ◯ 1 time per month
- ◯ 2–3 times per month
- ◯ 1 time per week
- ◯ 2 times per week
- ◯ 3–4 times per week
- ◯ 5–6 times per week
- ◯ 1 time per day
- ◯ 2 or more times per day

72a. How often were the other cold cuts or luncheon meats you ate **light, low-fat,** or **fat-free**? *(Please do not include ham, turkey, or chicken cold cuts.)*

- ◯ Almost never or never
- ◯ About 1/4 of the time
- ◯ About 1/2 of the time
- ◯ About 3/4 of the time
- ◯ Almost always or always

73. How often did you eat **canned tuna** (including in salads, sandwiches, or casseroles)?

- ◯ NEVER
- ◯ 1–6 times per year
- ◯ 7–11 times per year
- ◯ 1 time per month
- ◯ 2–3 times per month
- ◯ 1 time per week
- ◯ 2 times per week
- ◯ 3–4 times per week
- ◯ 5–6 times per week
- ◯ 1 time per day
- ◯ 2 or more times per day

74. How often did you eat **GROUND chicken** or **turkey**? *(We will ask about other chicken and turkey later.)*

- ◯ NEVER
- ◯ 1–6 times per year
- ◯ 7–11 times per year
- ◯ 1 time per month
- ◯ 2–3 times per month
- ◯ 1 time per week
- ◯ 2 times per week
- ◯ 3–4 times per week
- ◯ 5–6 times per week
- ◯ 1 time per day
- ◯ 2 or more times per day

75. How often did you eat **beef hamburgers** or **cheeseburgers**?

- ◯ NEVER **(GO TO QUESTION 76)**
- ◯ 1–6 times per year
- ◯ 7–11 times per year
- ◯ 1 time per month
- ◯ 2–3 times per month
- ◯ 1 time per week
- ◯ 2 times per week
- ◯ 3–4 times per week
- ◯ 5–6 times per week
- ◯ 1 time per day
- ◯ 2 or more times per day

75a. How often were the beef hamburgers or cheeseburgers you ate made with **lean ground beef**?

- ◯ Almost never or never
- ◯ About 1/4 of the time
- ◯ About 1/2 of the time
- ◯ About 3/4 of the time
- ◯ Almost always or always

76. How often did you eat **ground beef in mixtures** (such as meatballs, casseroles, chili, or meatloaf)?

- ◯ NEVER
- ◯ 1–6 times per year
- ◯ 7–11 times per year
- ◯ 1 time per month
- ◯ 2–3 times per month
- ◯ 1 time per week
- ◯ 2 times per week
- ◯ 3–4 times per week
- ◯ 5–6 times per week
- ◯ 1 time per day
- ◯ 2 or more times per day

77. How often did you eat **hot dogs** or **frankfurters**? *(Please do not include sausages or vegetarian hot dogs.)*

- ◯ NEVER **(GO TO QUESTION 78)**
- ◯ 1–6 times per year
- ◯ 7–11 times per year
- ◯ 1 time per month
- ◯ 2–3 times per month
- ◯ 1 time per week
- ◯ 2 times per week
- ◯ 3–4 times per week
- ◯ 5–6 times per week
- ◯ 1 time per day
- ◯ 2 or more times per day

77a. How often were the hot dogs or frankfurters you ate **light** or **low-fat hot dogs**?

- ◯ Almost never or never
- ◯ About 1/4 of the time
- ◯ About 1/2 of the time
- ◯ About 3/4 of the time
- ◯ Almost always or always

Question 78 appears on the next page.

Over the past 12 months...

78. How often did you eat beef mixtures such as **beef stew, beef pot pie, beef and noodles,** or **beef and vegetables**?

- ◯ NEVER

- ◯ 1–6 times per year
- ◯ 7–11 times per year
- ◯ 1 time per month
- ◯ 2–3 times per month
- ◯ 1 time per week
- ◯ 2 times per week
- ◯ 3–4 times per week
- ◯ 5–6 times per week
- ◯ 1 time per day
- ◯ 2 or more times per day

79. How often did you eat **roast beef** or **pot roast**? *(Please do not include roast beef or pot roast in sandwiches.)*

- ◯ NEVER

- ◯ 1–6 times per year
- ◯ 7–11 times per year
- ◯ 1 time per month
- ◯ 2–3 times per month
- ◯ 1 time per week
- ◯ 2 times per week
- ◯ 3–4 times per week
- ◯ 5–6 times per week
- ◯ 1 time per day
- ◯ 2 or more times per day

80. How often did you eat **steak** (beef)? (*Do not include steak in sandwiches*)

- ◯ NEVER **(GO TO QUESTION 81)**

- ◯ 1–6 times per year
- ◯ 7–11 times per year
- ◯ 1 time per month
- ◯ 2–3 times per month
- ◯ 1 time per week
- ◯ 2 times per week
- ◯ 3–4 times per week
- ◯ 5–6 times per week
- ◯ 1 time per day
- ◯ 2 or more times per day

80a. How often was the steak you ate **lean steak**?

- ◯ Almost never or never
- ◯ About 1/4 of the time
- ◯ About 1/2 of the time
- ◯ About 3/4 of the time
- ◯ Almost always or always

81. How often did you eat **pork** or **beef spareribs**?

- ◯ NEVER

- ◯ 1–6 times per year
- ◯ 7–11 times per year
- ◯ 1 time per month
- ◯ 2–3 times per month
- ◯ 1 time per week
- ◯ 2 times per week
- ◯ 3–4 times per week
- ◯ 5–6 times per week
- ◯ 1 time per day
- ◯ 2 or more times per day

82. How often did you eat **roast turkey, turkey cutlets,** or **turkey nuggets** (including in sandwiches)?

- ◯ NEVER

- ◯ 1–6 times per year
- ◯ 7–11 times per year
- ◯ 1 time per month
- ◯ 2–3 times per month
- ◯ 1 time per week
- ◯ 2 times per week
- ◯ 3–4 times per week
- ◯ 5–6 times per week
- ◯ 1 time per day
- ◯ 2 or more times per day

83. How often did you eat **chicken** as part of **salads, sandwiches, casseroles, stews,** or **other mixtures**?

- ◯ NEVER

- ◯ 1–6 times per year
- ◯ 7–11 times per year
- ◯ 1 time per month
- ◯ 2–3 times per month
- ◯ 1 time per week
- ◯ 2 times per week
- ◯ 3–4 times per week
- ◯ 5–6 times per week
- ◯ 1 time per day
- ◯ 2 or more times per day

84. How often did you eat **baked, broiled, roasted, stewed,** or **fried chicken** (including nuggets)? *(Please do not include chicken in mixtures.)*

- ◯ NEVER **(GO TO QUESTION 85)**

- ◯ 1–6 times per year
- ◯ 7–11 times per year
- ◯ 1 time per month
- ◯ 2–3 times per month
- ◯ 1 time per week
- ◯ 2 times per week
- ◯ 3–4 times per week
- ◯ 5–6 times per week
- ◯ 1 time per day
- ◯ 2 or more times per day

84a. How often was the chicken you ate **fried chicken** (including deep fried) or **chicken nuggets**?

- ◯ Almost never or never
- ◯ About 1/4 of the time
- ◯ About 1/2 of the time
- ◯ About 3/4 of the time
- ◯ Almost always or always

84b. How often was the chicken you ate **WHITE meat**?

- ◯ Almost never or never
- ◯ About 1/4 of the time
- ◯ About 1/2 of the time
- ◯ About 3/4 of the time
- ◯ Almost always or always

Question 85 appears on the next page.

Over the past 12 months...

84c. How often did you eat chicken **WITH skin**?

- ◯ Almost never or never
- ◯ About 1/4 of the time
- ◯ About 1/2 of the time
- ◯ About 3/4 of the time
- ◯ Almost always or always

85. How often did you eat **baked ham** or **ham steak**?

- ◯ NEVER

- ◯ 1–6 times per year
- ◯ 7–11 times per year
- ◯ 1 time per month
- ◯ 2–3 times per month
- ◯ 1 time per week
- ◯ 2 times per week
- ◯ 3–4 times per week
- ◯ 5–6 times per week
- ◯ 1 time per day
- ◯ 2 or more times per day

86. How often did you eat **pork** (including chops, roasts, and in mixed dishes)? *(Please do not include ham, ham steak, or sausage.)*

- ◯ NEVER

- ◯ 1–6 times per year
- ◯ 7–11 times per year
- ◯ 1 time per month
- ◯ 2–3 times per month
- ◯ 1 time per week
- ◯ 2 times per week
- ◯ 3–4 times per week
- ◯ 5–6 times per week
- ◯ 1 time per day
- ◯ 2 or more times per day

87. How often did you eat **gravy** on meat, chicken, potatoes, rice, etc.?

- ◯ NEVER

- ◯ 1–6 times per year
- ◯ 7–11 times per year
- ◯ 1 time per month
- ◯ 2–3 times per month
- ◯ 1 time per week
- ◯ 2 times per week
- ◯ 3–4 times per week
- ◯ 5–6 times per week
- ◯ 1 time per day
- ◯ 2 or more times per day

88. How often did you eat **liver** (all kinds) or **liverwurst**?

- ◯ NEVER

- ◯ 1–6 times per year
- ◯ 7–11 times per year
- ◯ 1 time per month
- ◯ 2–3 times per month
- ◯ 1 time per week
- ◯ 2 times per week
- ◯ 3–4 times per week
- ◯ 5–6 times per week
- ◯ 1 time per day
- ◯ 2 or more times per day

89. How often did you eat **bacon** (including low-fat)?

- ◯ NEVER **(GO TO QUESTION 90)**

- ◯ 1–6 times per year
- ◯ 7–11 times per year
- ◯ 1 time per month
- ◯ 2–3 times per month
- ◯ 1 time per week
- ◯ 2 times per week
- ◯ 3–4 times per week
- ◯ 5–6 times per week
- ◯ 1 time per day
- ◯ 2 or more times per day

89a. How often was the bacon you ate **light, low-fat,** or **lean bacon**?

- ◯ Almost never or never
- ◯ About 1/4 of the time
- ◯ About 1/2 of the time
- ◯ About 3/4 of the time
- ◯ Almost always or always

90. How often did you eat **sausage** (including low-fat)?

- ◯ NEVER **(GO TO QUESTION 91)**

- ◯ 1–6 times per year
- ◯ 7–11 times per year
- ◯ 1 time per month
- ◯ 2–3 times per month
- ◯ 1 time per week
- ◯ 2 times per week
- ◯ 3–4 times per week
- ◯ 5–6 times per week
- ◯ 1 time per day
- ◯ 2 or more times per day

90a. How often was the sausage you ate **light, low-fat,** or **lean sausage**?

- ◯ Almost never or never
- ◯ About 1/4 of the time
- ◯ About 1/2 of the time
- ◯ About 3/4 of the time
- ◯ Almost always or always

91. How often did you eat **smoked fish** or **seafood** (such as smoked salmon, lox, or others)?

- ◯ NEVER

- ◯ 1–6 times per year
- ◯ 7–11 times per year
- ◯ 1 time per month
- ◯ 2–3 times per month
- ◯ 1 time per week
- ◯ 2 times per week
- ◯ 3–4 times per week
- ◯ 5–6 times per week
- ◯ 1 time per day
- ◯ 2 or more times per day

92. How often did you eat **sushi**?

- ◯ NEVER **(GO TO QUESTION 93)**

- ◯ 1–6 times per year
- ◯ 7–11 times per year
- ◯ 1 time per month
- ◯ 2–3 times per month
- ◯ 1 time per week
- ◯ 2 times per week
- ◯ 3–4 times per week
- ◯ 5–6 times per week
- ◯ 1 time per day
- ◯ 2 or more times per day

Question 93 appears on the next page.

Over the past 12 months...

92a. How often did the **sushi** you ate contain **raw fish** or **seafood** (including shellfish)?

- ◯ Almost never or never
- ◯ About 1/4 of the time
- ◯ About 1/2 of the time
- ◯ About 3/4 of the time
- ◯ Almost always or always

93. How often did you eat **raw oysters, raw clams,** or **other raw fish** (not including raw fish in sushi)?

- ◯ NEVER
- ◯ 1–6 times per year
- ◯ 7–11 times per year
- ◯ 1 time per month
- ◯ 2–3 times per month
- ◯ 1 time per week
- ◯ 2 times per week
- ◯ 3–4 times per week
- ◯ 5–6 times per week
- ◯ 1 time per day
- ◯ 2 or more times per day

94. How often did you eat **fish sticks** or **fried fish** (including fried seafood or shellfish)?

- ◯ NEVER
- ◯ 1–6 times per year
- ◯ 7–11 times per year
- ◯ 1 time per month
- ◯ 2–3 times per month
- ◯ 1 time per week
- ◯ 2 times per week
- ◯ 3–4 times per week
- ◯ 5–6 times per week
- ◯ 1 time per day
- ◯ 2 or more times per day

95. How often did you eat **all other fish** or **seafood** (including shellfish) that was **NOT FRIED, SMOKED,** or **RAW** ?

- ◯ NEVER
- ◯ 1–6 times per year
- ◯ 7–11 times per year
- ◯ 1 time per month
- ◯ 2–3 times per month
- ◯ 1 time per week
- ◯ 2 times per week
- ◯ 3–4 times per week
- ◯ 5–6 times per week
- ◯ 1 time per day
- ◯ 2 or more times per day

96. How often did you eat **tofu**, **soy burgers**, or **soy meat-substitutes**?

- ◯ NEVER
- ◯ 1–6 times per year
- ◯ 7–11 times per year
- ◯ 1 time per month
- ◯ 2–3 times per month
- ◯ 1 time per week
- ◯ 2 times per week
- ◯ 3–4 times per week
- ◯ 5–6 times per week
- ◯ 1 time per day
- ◯ 2 or more times per day

97. Over the past 12 months, did you eat **soups**?

- ◯ NO **(GO TO QUESTION 98)**
- ◯ YES

97a. How often did you eat **soup DURING THE WINTER**?

- ◯ NEVER
- ◯ 1–6 times per winter
- ◯ 7–11 times per winter
- ◯ 1 time per month
- ◯ 2–3 times per month
- ◯ 1 time per week
- ◯ 2 times per week
- ◯ 3–4 times per week
- ◯ 5–6 times per week
- ◯ 1 time per day
- ◯ 2 or more times per day

97b. How often did you eat **soup DURING THE REST OF THE YEAR**?

- ◯ NEVER
- ◯ 1–6 times per year
- ◯ 7–11 times per year
- ◯ 1 time per month
- ◯ 2–3 times per month
- ◯ 1 time per week
- ◯ 2 times per week
- ◯ 3–4 times per week
- ◯ 5–6 times per week
- ◯ 1 time per day
- ◯ 2 or more times per day

97c. How often were the soups you ate **bean soups**?

- ◯ Almost never or never
- ◯ About 1/4 of the time
- ◯ About 1/2 of the time
- ◯ About 3/4 of the time
- ◯ Almost always or always

97d. How often were the soups you ate **cream soups** (including chowders)?

- ◯ Almost never or never
- ◯ About 1/4 of the time
- ◯ About 1/2 of the time
- ◯ About 3/4 of the time
- ◯ Almost always or always

97e. How often were the soups you ate **tomato** or **vegetable soups**?

- ◯ Almost never or never
- ◯ About 1/4 of the time
- ◯ About 1/2 of the time
- ◯ About 3/4 of the time
- ◯ Almost always or always

Question 98 appears on the next page.

Over the past 12 months...

97f. How often were the soups you ate **broth soups** (including chicken) **with** or **without noodles** or **rice**?

- ◯ Almost never or never
- ◯ About 1/4 of the time
- ◯ About 1/2 of the time
- ◯ About 3/4 of the time
- ◯ Almost always or always

98. How often did you eat **pizza**?

- ◯ NEVER **(GO TO QUESTION 99)**

- ◯ 1–6 times per year
- ◯ 7–11 times per year
- ◯ 1 time per month
- ◯ 2–3 times per month
- ◯ 1 time per week
- ◯ 2 times per week
- ◯ 3–4 times per week
- ◯ 5–6 times per week
- ◯ 1 time per day
- ◯ 2 or more times per day

98a. How often did you eat pizza with **pepperoni, sausage,** or **other meat**?

- ◯ Almost never or never
- ◯ About 1/4 of the time
- ◯ About 1/2 of the time
- ◯ About 3/4 of the time
- ◯ Almost always or always

99. How often did you eat **crackers**?

- ◯ NEVER

- ◯ 1–6 times per year
- ◯ 7–11 times per year
- ◯ 1 time per month
- ◯ 2–3 times per month
- ◯ 1 time per week
- ◯ 2 times per week
- ◯ 3–4 times per week
- ◯ 5–6 times per week
- ◯ 1 time per day
- ◯ 2 or more times per day

100. How often did you eat **corn bread** or **corn muffins**?

- ◯ NEVER

- ◯ 1–6 times per year
- ◯ 7–11 times per year
- ◯ 1 time per month
- ◯ 2–3 times per month
- ◯ 1 time per week
- ◯ 2 times per week
- ◯ 3–4 times per week
- ◯ 5–6 times per week
- ◯ 1 time per day
- ◯ 2 or more times per day

101. How often did you eat **biscuits**?

- ◯ NEVER

- ◯ 1–6 times per year
- ◯ 7–11 times per year
- ◯ 1 time per month
- ◯ 2–3 times per month
- ◯ 1 time per week
- ◯ 2 times per week
- ◯ 3–4 times per week
- ◯ 5–6 times per week
- ◯ 1 time per day
- ◯ 2 or more times per day

102. How often did you eat **potato chips** (including low-fat, fat-free, or low-salt)?

- ◯ NEVER **(GO TO QUESTION 103)**

- ◯ 1–6 times per year
- ◯ 7–11 times per year
- ◯ 1 time per month
- ◯ 2–3 times per month
- ◯ 1 time per week
- ◯ 2 times per week
- ◯ 3–4 times per week
- ◯ 5–6 times per week
- ◯ 1 time per day
- ◯ 2 or more times per day

102a. How often were the potato chips you ate **low-fat** or **fat-free chips**?

- ◯ Almost never or never
- ◯ About 1/4 of the time
- ◯ About 1/2 of the time
- ◯ About 3/4 of the time
- ◯ Almost always or always

103. How often did you eat **tortilla chips** or **corn chips** (including low-fat, fat-free, or low-salt)?

- ◯ NEVER **(GO TO QUESTION 104)**

- ◯ 1–6 times per year
- ◯ 7–11 times per year
- ◯ 1 time per month
- ◯ 2–3 times per month
- ◯ 1 time per week
- ◯ 2 times per week
- ◯ 3–4 times per week
- ◯ 5–6 times per week
- ◯ 1 time per day
- ◯ 2 or more times per day

103a. How often were the tortilla or corn chips you ate **low-fat** or **fat-free chips**?

- ◯ Almost never or never
- ◯ About 1/4 of the time
- ◯ About 1/2 of the time
- ◯ About 3/4 of the time
- ◯ Almost always or always

104. How often did you eat **popcorn** (including low-fat)?

- ◯ NEVER

- ◯ 1–6 times per year
- ◯ 7–11 times per year
- ◯ 1 time per month
- ◯ 2–3 times per month
- ◯ 1 time per week
- ◯ 2 times per week
- ◯ 3–4 times per week
- ◯ 5–6 times per week
- ◯ 1 time per day
- ◯ 2 or more times per day

105. How often did you eat **pretzels**?

- ◯ NEVER

- ◯ 1–6 times per year
- ◯ 7–11 times per year
- ◯ 1 time per month
- ◯ 2–3 times per month
- ◯ 1 time per week
- ◯ 2 times per week
- ◯ 3–4 times per week
- ◯ 5–6 times per week
- ◯ 1 time per day
- ◯ 2 or more times per day

3/8" SPIN

Over the past 12 months...

106. How often did you eat **peanuts, walnuts, seeds,** or **other nuts**?

- ◯ NEVER
- ◯ 1–6 times per year
- ◯ 7–11 times per year
- ◯ 1 time per month
- ◯ 2–3 times per month
- ◯ 1 time per week
- ◯ 2 times per week
- ◯ 3–4 times per week
- ◯ 5–6 times per week
- ◯ 1 time per day
- ◯ 2 or more times per day

107. How often did you eat **granola bars**?

- ◯ NEVER
- ◯ 1–6 times per year
- ◯ 7–11 times per year
- ◯ 1 time per month
- ◯ 2–3 times per month
- ◯ 1 time per week
- ◯ 2 times per week
- ◯ 3–4 times per week
- ◯ 5–6 times per week
- ◯ 1 time per day
- ◯ 2 or more times per day

108. How often did you eat **yogurt** (NOT including frozen yogurt)?

- ◯ NEVER
- ◯ 1–6 times per year
- ◯ 7–11 times per year
- ◯ 1 time per month
- ◯ 2–3 times per month
- ◯ 1 time per week
- ◯ 2 times per week
- ◯ 3–4 times per week
- ◯ 5–6 times per week
- ◯ 1 time per day
- ◯ 2 or more times per day

109. How often did you eat **cottage cheese** (including low-fat)?

- ◯ NEVER
- ◯ 1–6 times per year
- ◯ 7–11 times per year
- ◯ 1 time per month
- ◯ 2–3 times per month
- ◯ 1 time per week
- ◯ 2 times per week
- ◯ 3–4 times per week
- ◯ 5–6 times per week
- ◯ 1 time per day
- ◯ 2 or more times per day

110. How often did you eat **cheese** (including low-fat; including on cheeseburgers or in sandwiches or subs)?

- ◯ NEVER **(GO TO QUESTION 111)**
- ◯ 1–6 times per year
- ◯ 7–11 times per year
- ◯ 1 time per month
- ◯ 2–3 times per month
- ◯ 1 time per week
- ◯ 2 times per week
- ◯ 3–4 times per week
- ◯ 5–6 times per week
- ◯ 1 time per day
- ◯ 2 or more times per day

Question 111 appears in the next column.

110a. How often was the cheese you ate **light** or **low-fat cheese**?

- ◯ Almost never or never
- ◯ About 1/4 of the time
- ◯ About 1/2 of the time
- ◯ About 3/4 of the time
- ◯ Almost always or always

111. How often did you eat **frozen yogurt, sorbet,** or **ices** (including low-fat or fat-free)?

- ◯ NEVER
- ◯ 1–6 times per year
- ◯ 7–11 times per year
- ◯ 1 time per month
- ◯ 2–3 times per month
- ◯ 1 time per week
- ◯ 2 times per week
- ◯ 3–4 times per week
- ◯ 5–6 times per week
- ◯ 1 time per day
- ◯ 2 or more times per day

112. How often did you eat **ice cream, ice cream bars,** or **sherbet** (including low-fat or fat-free)?

- ◯ NEVER **(GO TO QUESTION 113)**
- ◯ 1–6 times per year
- ◯ 7–11 times per year
- ◯ 1 time per month
- ◯ 2–3 times per month
- ◯ 1 time per week
- ◯ 2 times per week
- ◯ 3–4 times per week
- ◯ 5–6 times per week
- ◯ 1 time per day
- ◯ 2 or more times per day

112a. How often was the ice cream you ate **light**, **low-fat**, or **fat-free ice cream** or **sherbet**?

- ◯ Almost never or never
- ◯ About 1/4 of the time
- ◯ About 1/2 of the time
- ◯ About 3/4 of the time
- ◯ Almost always or always

113. How often did you eat **pudding or custard**?

- ◯ NEVER
- ◯ 1–6 times per year
- ◯ 7–11 times per year
- ◯ 1 time per month
- ◯ 2–3 times per month
- ◯ 1 time per week
- ◯ 2 times per week
- ◯ 3–4 times per week
- ◯ 5–6 times per week
- ◯ 1 time per day
- ◯ 2 or more times per day

114. How often did you eat **cake** (including low-fat or fat-free)?

- ◯ NEVER
- ◯ 1–6 times per year
- ◯ 7–11 times per year
- ◯ 1 time per month
- ◯ 2–3 times per month
- ◯ 1 time per week
- ◯ 2 times per week
- ◯ 3–4 times per week
- ◯ 5–6 times per week
- ◯ 1 time per day
- ◯ 2 or more times per day

Over the past 12 months...

115. How often did you eat **cookies** or **brownies** (including low-fat or fat-free)?

- ◯ NEVER

- ◯ 1–6 times per year
- ◯ 7–11 times per year
- ◯ 1 time per month
- ◯ 2–3 times per month
- ◯ 1 time per week
- ◯ 2 times per week
- ◯ 3–4 times per week
- ◯ 5–6 times per week
- ◯ 1 time per day
- ◯ 2 or more times per day

116. How often did you eat **doughnuts, sweet rolls, Danish,** or **pop-tarts**?

- ◯ NEVER

- ◯ 1–6 times per year
- ◯ 7–11 times per year
- ◯ 1 time per month
- ◯ 2–3 times per month
- ◯ 1 time per week
- ◯ 2 times per week
- ◯ 3–4 times per week
- ◯ 5–6 times per week
- ◯ 1 time per day
- ◯ 2 or more times per day

117. How often did you eat **sweet muffins** or **dessert breads** (including low-fat or fat-free)?

- ◯ NEVER

- ◯ 1–6 times per year
- ◯ 7–11 times per year
- ◯ 1 time per month
- ◯ 2–3 times per month
- ◯ 1 time per week
- ◯ 2 times per week
- ◯ 3–4 times per week
- ◯ 5–6 times per week
- ◯ 1 time per day
- ◯ 2 or more times per day

118. How often did you eat **fruit crisp, cobbler,** or **strudel**?

- ◯ NEVER

- ◯ 1–6 times per year
- ◯ 7–11 times per year
- ◯ 1 time per month
- ◯ 2–3 times per month
- ◯ 1 time per week
- ◯ 2 times per week
- ◯ 3–4 times per week
- ◯ 5–6 times per week
- ◯ 1 time per day
- ◯ 2 or more times per day

119. How often did you eat **pie**?

- ◯ NEVER **(GO TO QUESTION 120)**

- ◯ 1–6 times per year
- ◯ 7–11 times per year
- ◯ 1 time per month
- ◯ 2–3 times per month
- ◯ 1 time per week
- ◯ 2 times per week
- ◯ 3–4 times per week
- ◯ 5–6 times per week
- ◯ 1 time per day
- ◯ 2 or more times per day

Question 120 appears in the next column.

119a. How often was the pie you ate **fruit pie** (such as apple, cherry, peach, blueberry, or others)?

- ◯ Almost never or never
- ◯ About 1/4 of the time
- ◯ About 1/2 of the time
- ◯ About 3/4 of the time
- ◯ Almost always or always

120. How often did you eat **chocolate candy**?

- ◯ NEVER

- ◯ 1–6 times per year
- ◯ 7–11 times per year
- ◯ 1 time per month
- ◯ 2–3 times per month
- ◯ 1 time per week
- ◯ 2 times per week
- ◯ 3–4 times per week
- ◯ 5–6 times per week
- ◯ 1 time per day
- ◯ 2 or more times per day

121. How often did you eat **other candy**?

- ◯ NEVER

- ◯ 1–6 times per year
- ◯ 7–11 times per year
- ◯ 1 time per month
- ◯ 2–3 times per month
- ◯ 1 time per week
- ◯ 2 times per week
- ◯ 3–4 times per week
- ◯ 5–6 times per week
- ◯ 1 time per day
- ◯ 2 or more times per day

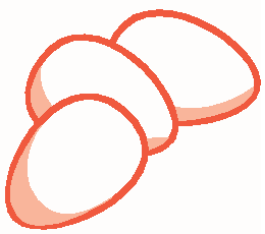
122. How often did you eat **eggs, egg whites,** or **egg substitutes** (NOT counting eggs in baked goods and desserts)? *(Please include eggs in salads, quiche, and souffles.)*

- ◯ NEVER **(GO TO QUESTION 123)**

- ◯ 1–6 times per year
- ◯ 7–11 times per year
- ◯ 1 time per month
- ◯ 2–3 times per month
- ◯ 1 time per week
- ◯ 2 times per week
- ◯ 3–4 times per week
- ◯ 5–6 times per week
- ◯ 1 time per day
- ◯ 2 or more times per day

122a. How often were the eggs you ate **egg substitutes**?

- ◯ Almost never or never
- ◯ About 1/4 of the time
- ◯ About 1/2 of the time
- ◯ About 3/4 of the time
- ◯ Almost always or always



Question 123 appears on the next page.

3/8" SPIN

Over the past 12 months...

122b. How often were the eggs you ate **egg whites only**?

- ◯ Almost never or never
- ◯ About 1/4 of the time
- ◯ About 1/2 of the time
- ◯ About 3/4 of the time
- ◯ Almost always or always

122c. How often were the eggs you ate **regular whole eggs**?

- ◯ Almost never or never
- ◯ About 1/4 of the time
- ◯ About 1/2 of the time
- ◯ About 3/4 of the time
- ◯ Almost always or always

122d. How often were the eggs you ate part of **egg salad**?

- ◯ Almost never or never
- ◯ About 1/4 of the time
- ◯ About 1/2 of the time
- ◯ About 3/4 of the time
- ◯ Almost always or always

123. How many cups of **coffee,** caffeinated or decaffeinated, did you drink?

- ◯ NONE **(GO TO QUESTION 124)**
- ◯ Less than 1 cup per month
- ◯ 1–3 cups per month
- ◯ 1 cup per week
- ◯ 2–4 cups per week
- ◯ 5–6 cups per week
- ◯ 1 cup per day
- ◯ 2–3 cups per day
- ◯ 4–5 cups per day
- ◯ 6 or more cups per day

123a. How often was the coffee you drank **decaffeinated**?

- ◯ Almost never or never
- ◯ About 1/4 of the time
- ◯ About 1/2 of the time
- ◯ About 3/4 of the time
- ◯ Almost always or always

124. How many glasses of **ICED tea,** caffeinated or decaffeinated, did you drink?

- ◯ NONE **(GO TO QUESTION 125)**
- ◯ Less than 1 cup per month
- ◯ 1–3 cups per month
- ◯ 1 cup per week
- ◯ 2–4 cups per week
- ◯ 5–6 cups per week
- ◯ 1 cup per day
- ◯ 2–3 cups per day
- ◯ 4–5 cups per day
- ◯ 6 or more cups per day

Question 125 appears in the next column.

124a. How often was the iced tea you drank **decaffeinated** or **herbal tea**?

- ◯ Almost never or never
- ◯ About 1/4 of the time
- ◯ About 1/2 of the time
- ◯ About 3/4 of the time
- ◯ Almost always or always

125. How many cups of **HOT tea**, caffeinated or decaffeinated, did you drink?

- ◯ NONE **(GO TO QUESTION 126)**
- ◯ Less than 1 cup per month
- ◯ 1–3 cups per month
- ◯ 1 cup per week
- ◯ 2–4 cups per week
- ◯ 5–6 cups per week
- ◯ 1 cup per day
- ◯ 2–3 cups per day
- ◯ 4–5 cups per day
- ◯ 6 or more cups per day

125a. How often was the hot tea you drank **decaffeinated** or **herbal tea**?

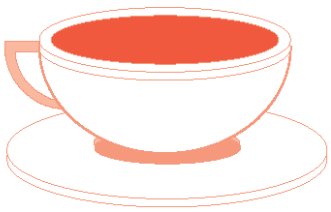
- ◯ Almost never or never
- ◯ About 1/4 of the time
- ◯ About 1/2 of the time
- ◯ About 3/4 of the time
- ◯ Almost always or always

126. How often did you add **sugar** or **honey** to your coffee or tea?

- ◯ NEVER
- ◯ Less than 1 time per month
- ◯ 1–3 times per month
- ◯ 1 time per week
- ◯ 2–4 times per week
- ◯ 5–6 times per week
- ◯ 1 time per day
- ◯ 2–3 times per day
- ◯ 4–5 times per day
- ◯ 6 or more times per day

127. How often did you add **artificial sweetener** to your coffee or tea?

- ◯ NEVER
- ◯ Less than 1 time per month
- ◯ 1–3 times per month
- ◯ 1 time per week
- ◯ 2–4 times per week
- ◯ 5–6 times per week
- ◯ 1 time per day
- ◯ 2–3 times per day
- ◯ 4–5 times per day
- ◯ 6 or more times per day



Over the past 12 months...

128. How often was **non-dairy creamer** added to your coffee or tea?

- ○ NEVER **(GO TO QUESTION 129)**
- ○ Less than 1 time per month
- ○ 1–3 times per month
- ○ 1 time per week
- ○ 2–4 times per week
- ○ 5–6 times per week
- ○ 1 time per day
- ○ 2–3 times per day
- ○ 4–5 times per day
- ○ 6 or more times per day

128a. What kind of **non-dairy creamer** did you usually use?

- ○ Regular powdered
- ○ Low-fat or fat-free powdered
- ○ Regular liquid
- ○ Low-fat or fat-free liquid

129. How often was **cream** or **half and half** added to your coffee or tea?

- ○ NEVER
- ○ Less than 1 time per month
- ○ 1–3 times per month
- ○ 1 time per week
- ○ 2–4 times per week
- ○ 5–6 times per week
- ○ 1 time per day
- ○ 2–3 times per day
- ○ 4–5 times per day
- ○ 6 or more times per day

130. How often was **milk** added to your coffee or tea?

- ○ NEVER **(GO TO QUESTION 131)**
- ○ Less than 1 time per month
- ○ 1–3 times per month
- ○ 1 time per week
- ○ 2–4 times per week
- ○ 5–6 times per week
- ○ 1 time per day
- ○ 2–3 times per day
- ○ 4–5 times per day
- ○ 6 or more times per day

130a. What kind of **milk** was usually added to your coffee or tea?

- ○ Whole milk
- ○ 2% milk
- ○ 1% milk
- ○ Skim, nonfat, or 1/2% milk
- ○ Evaporated or condensed (canned) milk
- ○ Soy milk
- ○ Rice milk
- ○ Raw, unpasteurized milk
- ○ Other

Question 131 appears in the next column.

131. How often was **sugar** or **honey** added to foods you ate? (Please do not include sugar in coffee, tea, other beverages, or baked goods.)

- ○ NEVER
- ○ 1–6 times per year
- ○ 7–11 times per year
- ○ 1 time per month
- ○ 2–3 times per month
- ○ 1 time per week
- ○ 2 times per week
- ○ 3–4 times per week
- ○ 5–6 times per week
- ○ 1 time per day
- ○ 2 or more times per day

132. How often did you eat **margarine** on breads, bagels, English muffins, other muffins, pancakes, or waffles?

- ○ NEVER **(GO TO QUESTION 133)**
- ○ 1–6 times per year
- ○ 7–11 times per year
- ○ 1 time per month
- ○ 2–3 times per month
- ○ 1 time per week
- ○ 2 times per week
- ○ 3–4 times per week
- ○ 5–6 times per week
- ○ 1 time per day
- ○ 2 or more times per day

132a. How often was the margarine you ate on these breads **low-fat** or **fat-free**?

- ○ Almost never or never
- ○ About 1/4 of the time
- ○ About 1/2 of the time
- ○ About 3/4 of the time
- ○ Almost always or always

133. How often did you eat **butter** on breads, bagels, English muffins, other muffins, pancakes, or waffles?

- ○ NEVER **(GO TO QUESTION 134)**
- ○ 1–6 times per year
- ○ 7–11 times per year
- ○ 1 time per month
- ○ 2–3 times per month
- ○ 1 time per week
- ○ 2 times per week
- ○ 3–4 times per week
- ○ 5–6 times per week
- ○ 1 time per day
- ○ 2 or more times per day

133a. How often was the butter you ate on these breads **low-fat** or **fat-free**?

- ○ Almost never or never
- ○ About 1/4 of the time
- ○ About 1/2 of the time
- ○ About 3/4 of the time
- ○ Almost always or always

Question 134 appears on the next page.

Over the past 12 months...

134. How often did you eat **margarine** on potatoes, cooked vegetables, rice, grains, or beans?

- ◯ NEVER **(GO TO QUESTION 135)**

- ◯ 1–6 times per year
- ◯ 7–11 times per year
- ◯ 1 time per month
- ◯ 2–3 times per month
- ◯ 1 time per week
- ◯ 2 times per week
- ◯ 3–4 times per week
- ◯ 5–6 times per week
- ◯ 1 time per day
- ◯ 2 or more times per day

134a. How often was the margarine you ate on these cooked potatoes, cooked vegetables, rice, grains, or beans **low-fat** or **fat-free**?

- ◯ Almost never or never
- ◯ About 1/4 of the time
- ◯ About 1/2 of the time
- ◯ About 3/4 of the time
- ◯ Almost always or always

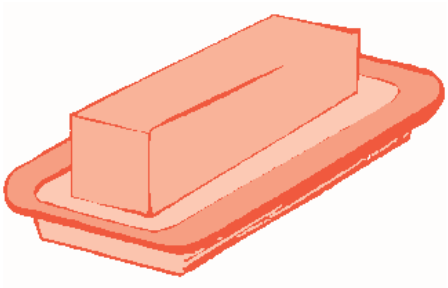
135. How often did you eat **butter** on potatoes, cooked vegetables, rice, grains, or beans?

- ◯ NEVER **(GO TO QUESTION 136)**

- ◯ 1–6 times per year
- ◯ 7–11 times per year
- ◯ 1 time per month
- ◯ 2–3 times per month
- ◯ 1 time per week
- ◯ 2 times per week
- ◯ 3–4 times per week
- ◯ 5–6 times per week
- ◯ 1 time per day
- ◯ 2 or more times per day

135a. How often was the butter you ate on these cooked potatoes, cooked vegetables, rice, grains, or beans **low-fat** or **fat-free**?

- ◯ Almost never or never
- ◯ About 1/4 of the time
- ◯ About 1/2 of the time
- ◯ About 3/4 of the time
- ◯ Almost always or always



Question 136 appears in the next column.

136. How often did you eat **mayonnaise** as a spread or as part of food mixtures?

- ◯ NEVER **(GO TO QUESTION 137)**

- ◯ 1–6 times per year
- ◯ 7–11 times per year
- ◯ 1 time per month
- ◯ 2–3 times per month
- ◯ 1 time per week
- ◯ 2 times per week
- ◯ 3–4 times per week
- ◯ 5–6 times per week
- ◯ 1 time per day
- ◯ 2 or more times per day

136a. How often was the mayonnaise you ate **low-fat** or **fat-free**?

- ◯ Almost never or never
- ◯ About 1/4 of the time
- ◯ About 1/2 of the time
- ◯ About 3/4 of the time
- ◯ Almost always or always

137. How often did you eat **cream cheese**?

- ◯ NEVER **(GO TO QUESTION 138)**

- ◯ 1–6 times per year
- ◯ 7–11 times per year
- ◯ 1 time per month
- ◯ 2–3 times per month
- ◯ 1 time per week
- ◯ 2 times per week
- ◯ 3–4 times per week
- ◯ 5–6 times per week
- ◯ 1 time per day
- ◯ 2 or more times per day

137a. How often was the cream cheese you ate **low-fat** or **fat-free**?

- ◯ Almost never or never
- ◯ About 1/4 of the time
- ◯ About 1/2 of the time
- ◯ About 3/4 of the time
- ◯ Almost always or always

Question 138 appears on the next page.

Over the past 12 months...

138. How often did you eat **sour cream**?

- ◯ NEVER **(GO TO QUESTION 139)**

- ◯ 1–6 times per year
- ◯ 7–11 times per year
- ◯ 1 time per month
- ◯ 2–3 times per month
- ◯ 1 time per week
- ◯ 2 times per week
- ◯ 3–4 times per week
- ◯ 5–6 times per week
- ◯ 1 time per day
- ◯ 2 or more times per day

138a. How often was the sour cream you ate **low-fat** or **fat-free**?

- ◯ Almost never or never
- ◯ About 1/4 of the time
- ◯ About 1/2 of the time
- ◯ About 3/4 of the time
- ◯ Almost always or always

Question 139 appears in the next column.

139. How often did you eat foods with **oils added** or with **oils used in cooking** (do not include baked goods or salads)?

- ◯ NEVER

- ◯ 1–6 times per year
- ◯ 7–11 times per year
- ◯ 1 time per month
- ◯ 2–3 times per month
- ◯ 1 time per week
- ◯ 2 times per week
- ◯ 3–4 times per week
- ◯ 5–6 times per week
- ◯ 1 time per day
- ◯ 2 or more times per day

139a. What kind of **oils** do you **usually eat**? ***(Mark all that apply.)***

- ◯ Olive
- ◯ Corn
- ◯ Canola/rapeseed
- ◯ Other

Thank you very much for completing this questionnaire! Because we want to be able to use all the information you have provided, we would greatly appreciate it if you would please take a moment to review each page making sure that you:

- ***Did not skip any pages,***
- ***Completely blackened-in each answer, and***
- ***Completely erased any changes you may have made.***

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