

WHICH AGRICULTURAL SECTORS BENEFIT FROM
THE LOW-CARBOHYDRATE DIET MOVEMENT: A
SURVEY OF CONSUMER PERCEPTIONS OF
HEALTHY FOOD SUBSTITUTES ON A LOW-
CARBOHYDRATE DIET

By

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Abstract:

Since 1980, it has been a responsibility of the United States Department of Health and Human Services (HHS) and the United States Department of Agriculture (USDA) to review the Dietary Guidelines every five years and update them if necessary. Several studies have shown that many Americans are aware of the dietary guidelines but choose not to follow the guidelines for various reasons (Gregory, Smith, and Wendt 2011). In 2012, ABC News estimated that 108 million Americans were on a diet, and that the annual revenue of the diet industry was approximately \$20 billion (ABC News 2012). It is clear that the diet industry plays a major role in the lives of many Americans. These diets vary greatly in their approach and methodology for successful weight loss. Some popular diets encourage the reduction of carbohydrates such as the Atkins, South Beach and Paleo diets, which are also referred to as low-carbohydrate diets.

This research evaluates potential impacts of low-carbohydrate diets on various sectors of the agricultural industry. More specifically, this research examines consumer preferences and perceptions of healthy carbohydrate substitutes while attempting to lose weight on a low-carbohydrate diet.

A survey was conducted to evaluate the perception of diets and nutrition. Ordered logit models were estimated to analyze survey responses. In the first model, consumer perceptions regarding the effectiveness of particular diets were evaluated. A second model was estimated to determine if a statistically significant difference existed between diet ratings by individuals with an overweight or obese BMI (body mass index) and those with a healthy BMI.

Results showed that the vegetable industry is more positively impacted than animal agriculture by the popularity of low-carbohydrate diets. BMI did not have a significant impact on perceptions of diets.

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CHAPTER I

INTRODUCTION

In 2013, 69% of Americans over the age of 20, and 31% of youths were considered overweight or obese (Ogden et al. 2014). Because of bleak statistics such as these, diet, nutrition and the overall state of health in America are of concern for U.S. policymakers. Many government agencies have policies to promote healthy habits and the importance of maintaining a healthy weight.

Since 1980, it has been a responsibility of the United States Department of Health and Human Services (HHS) and the United States Department of Agriculture (USDA) to review the Dietary Guidelines every five years and update them if necessary (U.S. Department of Agriculture 2010). These guidelines are used as the basis for federal nutrition assistance programs. Some behaviors encouraged by the 2010 Dietary Guidelines were a reduction in sodium intake, less saturated and trans fats, more vegetable and fruit intake, more whole grains, more low-fat dairy products, and eating a variety of proteins (U.S. Department of Agriculture 2010). Several studies have shown that many Americans are aware of the dietary guidelines but choose not to follow the guidelines for various reasons (Gregory, Smith, and Wendt 2011).

In 2012, ABC News estimated that 108 million Americans were on a diet intended to result in weight loss and that the annual revenue of the diet industry was approximately \$20 billion (ABC News 2012). It is clear that the diet industry plays a major role in the lives of many Americans. These diets vary greatly in their approach and methodology for successful weight loss. Some popular diets encourage the reduction of carbohydrates such as the Atkins, South Beach and Paleo diets, which are also referred to as low-carbohydrate diets.

Objectives

General Objective

This research evaluates potential impacts of low-carbohydrate diets on various sectors of the agricultural industry. More specifically, this research examines consumer preferences and perceptions of healthy carbohydrate substitutes while attempting to lose weight on a low-carbohydrate diet.

Specific Objectives

Three specific objectives were examined.

1. To determine if consumers prefer to replace carbohydrates with animal products, such as beef, dairy, and eggs, while on a low-carbohydrate diet;
2. To determine if consumers prefer to replace carbohydrates with specialty crops, such as vegetables, while on a low-carbohydrate diet;
3. To evaluate the influence of body mass index (BMI) on consumer preference for animal or vegetable products while on a low-carbohydrate diet.

CHAPTER II

REVIEW OF LITERATURE

Overview

Dietary guidance and policy in the United States have focused highly on diets low in fat and high in carbohydrates since the mid-1970's (Gray 2012). However, low-carbohydrate diets receive much attention in popular media and scientific debate. Contradictory reports of the wholesomeness of low-carbohydrate diets can cause confusion to consumers (Gray 2012; Slavin 2012; Hite et al. 2010). Further, it is uncertain how consumers' intake of meat, vegetables, and dairy would change if they were to choose one of these diets. Since these remaining food groups from the Dietary Guidelines are staples in the U.S. agricultural industry, this research looks at which sector of the agricultural industry has the potential to benefit most from low-carbohydrate diets.

Nutrition Policy and Implementation

The first Dietary Guidelines were released to the public in 1980. One goal of the guidelines was to help Americans fight chronic diseases, such as diabetes, heart disease,

cancer, and obesity, brought on by over-eating. However, these diseases are now more widespread than ever (Rowe et al. 2011).

It is commonly known that Americans do not follow all of the recommendations in the Dietary Guidelines (Mancino and Kuchler 2012). For example, many Americans are consuming more calories than they can burn and are still not meeting the nutrient levels recommended by the Dietary Guidelines (Nicklas et al. 2013). In addition, a report from the Centers for Disease Control (2010) showed that following the publication of the Dietary Guidelines in 2000 and 2005, there was no increase in vegetable consumption and that fruit intake had actually decreased (CDC 2010). This makes one question whether or not the guidelines are worthwhile.

A study by Mancino and Kuchler (2012) evaluated the 2005 Dietary Guidelines' effect on demand for whole grain bread. The guidelines suggested a substitution of whole grains for refined grains. Subsequent to the study's release, there was an increase in whole grain purchases. Their study hoped to address whether or not this increase in whole grain purchases was due to the new Dietary Guidelines. Results showed that the 2005 Dietary Guidelines did cause a change in dietary pattern towards higher whole grain consumption (Mancino and Kuchler 2012). It is assumed that this change could have taken place due to the ease at which a whole grain loaf of bread can be substituted for a refined grain loaf of bread without a change in lifestyle. This suggests that when a recommendation is small and simple to understand, consumers are more likely to follow it (Mancino and Kuchler 2012). Similarly, Nicklas et al. (2013) recommended that for Americans to better implement healthy eating habits, policy makers should focus on one food group at a time.

Rowe et al. (2011) suggests that the lack of change in Americans' eating behavior is due to a lack of communication between those creating the guidelines and the citizenry. Many barriers prevent food production companies from creating healthier food options including product development costs, consumer research, higher cost of alternative ingredients, and promotional expenses. Even though food manufacturers may decrease trans fats, sodium or other ingredients that cause health problems, they cannot control how many servings a consumer eats. Moreover, effort may be put into an innovative, nutritious product, and at its release, there may be no interest from the public to purchase it (Rowe et al. 2011).

Barriers also exist on the consumer side. For example, often food preferences are based on cultural, socioeconomic and family preferences. Consumers often perceive fruits and vegetables to be more expensive than less healthy alternatives. Another barrier is convenience. As more women work outside of the home, more families dine out on a regular basis (Rowe et al. 2011). These foods are typically less healthy than meals cooked at home. Joe Derochowski, with NPD Group, which specializes in consumer behavior, stated, "Mom is the key to fully integrating the Dietary Guidelines into her family's lifestyle. In order for her to accomplish this, we need to make it easy and seamless for her. The guidelines need to become part of the daily routine, quick and convenient to apply throughout the day, everyday. Since home is the primary source of meals, how can she easily implement the Dietary Guidelines into meal planning for her family (Rowe et al. 2011)?"

Changing the way Americans eat should be looked at as a longer-term goal than it currently is because many dietary habits are created in childhood and are hard to break.

More emphasis should be directed toward educating children about healthy choices; as they grow into adults, it will be natural for them to choose foods with higher nutritional benefit per calorie (Rowe et al. 2011).

The 2015 Dietary Guidelines for Americans are expected to be published in the fall of 2015 (U.S. HHS 2014). At the Dietary Guidelines Advisory Committee public meeting in January 2014, some major topics discussed were: 1) emphasis on plant-based diets; 2) importance of sustainability; 3) dietary patterns; 4) cultural sensitivity and acculturation; 5) personal responsibility and societal responsibility; 6) whole grains, refined grains, and gluten; and 7) sodium and caffeine recommendations (Oldways 2014). Undoubtedly, many of these topics have direct ties to production agriculture.

Perspectives on Nutrition

Gregory, Smith, and Wendt (2011), with the USDA Economic Research Service, assessed Americans' perspectives on their eating habits. In order to determine if Americans are realistic about their eating habits and how they relate to health, data were examined from the 1989-91 Continuing Survey of Food Intakes of Individuals and the 2005-08 Flexible Consumer Behavior Survey. The study found that Americans were much less likely to rate their diet as "excellent" or "very good" in the later survey. The wholesomeness of individuals' diets has changed little since the first survey, so one can deduce individuals are increasingly aware of their unhealthy eating habits, but are not motivated to make significant changes (Gregory, Smith, and Wendt 2011).

Another finding in the study was that self-rating of diets was inversely related to dining out frequency and use of sweetened soft drinks. In other words, the more an

individual eats at restaurants and drinks soft drinks, the lower they rate the nutrition of their diet. Conversely, individuals who self-rated their diet as nutritious were more likely to eat dark, green vegetables and drink low-fat milk. Although there is merit in this, the overall conclusion was made that there is inaccuracy in how consumers perceive their dietary habits (Gregory, Smith, and Wendt 2011).

America is not alone in its lack of execution of dietary guidelines. Obesity is now a major cause of illness around the world. For example, a 2014 study conducted in Canada found that only 25% of those surveyed said they were overweight or obese, while the Canadian Community Health Survey states that 59% of Canadians are overweight or obese (Schermer et al. 2014). In addition, Kearney and McElhone (1999) found that nearly 80% of residents of the European Union face barriers to eating a healthier diet.

Australian researchers, Buzzacott et al. (2013), analyzed adults' attitudes toward maintaining or losing weight. In Australia, 7.5% of diseases can be solely attributed to high body mass index. In comparison, tobacco use is the leading cause of disease that could be remedied through a change in behavior at 7.8%.

According to Buzzacott et al. (2013), age, gender, socio-economic status, and education are highly associated with an individual's willingness to lose weight. They focused on identifying characteristics associated with people who were actively trying to maintain or lose weight and found that in all but one BMI group, women were more actively trying to lose weight than men. Typically, men in the healthy or overweight BMI category said that their weight was "just right." Men who were in the obese BMI category

were willing to admit that they were not in a healthy weight range. BMI was concluded to be the strongest predictor of willingness to lose or maintain one's weight.

A common thread in many nutrition studies is that a physician's suggestion to lose weight is seen as much more motivating than a family member or friend (Buzzacot et al. 2013, Kearney and McElhone 1999).

According to Feinman, Vernon, and Westman (2006), physicians should be open minded toward low-carbohydrate diets and should encourage individuals who are on a low-carbohydrate diet to greatly increase vegetable intake and make slight increases in fats and protein. The 2010 International Food Information Council Foundation survey found that 50% of respondents were interested in increasing their protein intake and 37% believed that increased protein aids in weight loss (Elsevier Health Sciences 2013). Weight loss through low-carbohydrate diets has been seen as a controversial way to control diabetes and cardiovascular disease (Feinman, Vernon, and Westman 2006). Some opponents of low-carbohydrate diets cite an increase in beef, bacon, and butter as the reason this diet is not healthy.

Feinman, Vernon, and Westman (2006) conducted a survey of a support group called The Active Low-Carber Forums (ALCF). The online support group had over 86,000 members. Those who participated in the survey were asked questions similar to those in our study (Appendix A) such as, "Which low-carb plan did you follow for losing weight," and "Which of the following have you increased to replace those carbohydrates that you cut out?" Responses to the latter question showed that only 22% of respondents increased one of the "hot-button" foods of beef, bacon, and butter. The study showed that

the largest-food-group increases were vegetables and lettuce (Feinman, Vernon, and Westman 2006). One difference between this and our study is that ours did not require that participants have experience with a low-carbohydrate diet, because we were interested in evaluating the perceptions of the low-carbohydrate diet.

When asked which factors were most important for losing weight, those surveyed responded in decreasing importance: avoiding sugar, avoiding starch, drinking water, eating vegetables, exercise, increasing protein, avoiding soft-drinks, increasing fat, eating fruits and decreasing fat. The survey also had an open comment section. Out of more than 1,000 people, the most frequent comment was that they had more energy.

The Effect of Diets on Agriculture

Many studies have been conducted to evaluate the impacts of USDA Dietary Guidelines and other popular diets on production agriculture. In 1986, Orville K. Sweet, Executive Vice President of the National Pork Producers Council, wrote an article in the *Journal of Animal Science*. He stated that the 1985 USDA Dietary Guidelines were viewed as controversial by livestock groups but were quickly accepted by the general populace. Many livestock producers were frustrated with the switch from meat, especially red meat, once being viewed as a healthy part of one's diet, to a food to be avoided (Sweet 1986). USDA data showed a 22% drop in beef demand from 1975-1986. During this time, there was an increase in chicken consumption. A survey indicated that from 1983 to 1985, there was a 17% drop in the number of households that held pro-meat attitudes. That was a decrease from 67% to 50%.

In 1995, O'Brien wrote about the gaps between dietary recommendations for Americans and what they actually eat. By asking two basic questions, the study evaluated how a shift to a diet strictly following the Food Guide Pyramid or a Mediterranean diet would affect American agriculture. Those questions were: "What changes in demand for basic commodities can be anticipated in a shift toward healthier diets, and how would the agricultural sector adjust to such changes (O'Brien 1995)?"

Mediterranean diets include large amounts of fruits, vegetables, bread, pasta, other grain products and olive oil. There is limited consumption of red meat and dairy products and high consumption of fish. These diets became popular because diseases caused by being overweight or obese are rare in areas of the world where this type of diet is traditionally followed (O'Brien 1995).

Because it is common for Americans to underreport the amount of food they eat, this research used data on commodity disappearance to report how much Americans were eating (O'Brien 1995). The 1990 Dietary Guidelines recommended the following: 1) eat a variety of food; 2) maintain a healthy weight; 3) choose a diet low in fat; 4) choose a diet with plenty of vegetables; and 5) use sugars and sodium only in moderation.

Surveys suggested that Americans were eating only two servings of vegetables and one serving of fruit each day, while the recommended servings were twice that amount (O'Brien 1995). Results from the paper showed that American agriculture should greatly increase fruit and vegetable production. There also should be a moderate increase in cereals, a different mix of dairy products and a different mix of meat products. There should be a large decrease in fats and oils and a moderate decrease in sugars and

sweeteners. The author suggested that government farm policies should be used to shift incentives for farmers to produce commodities that follow these guidelines (O'Brien 1995).

Similarly, Abbot (1999) asked the question, "Can U.S. agriculture produce the basic foodstuffs consistent with the Dietary Guidelines?" This article evaluated American agriculture's ability to contribute to healthier diets and barriers preventing the agriculture industry from doing so. If Americans demand a healthier diet, not only will this affect production patterns in the U.S., but also greater diversity in international trade patterns (Abbot 1999).

At the time of the study, U.S. exports of meat, vegetables and fruits had increased steadily since 1986 (Abbot 1999). Abbot (1999) concluded that for agriculturalists to produce more dairy, fruits and vegetables, demand, reflected by higher prices, would have to be observed. Another conclusion was consumer demand was holding back fruit and vegetable production, not the lack of ability to produce (Abbot 1999).

In 2008, Arnoult et al. (2008), evaluated the impact of healthy-eating guidelines in England and Wales. This study used household-food-consumption data to assess the state of diets in England and Wales, and determined how agriculture would be affected if people changed their diets to follow the healthy eating guidelines of the U.K. They found that if the guidelines were followed, there would be a strong decrease in the consumption of saturated fats and sugars. Therefore, the amount of cheese, sugar and meats high in fat would decrease and fruits and vegetables, cereals and flour would increase.

Regions with intensive livestock production would be negatively affected because of the decrease in meat and cheese consumption. These areas would experience sharp declines in the amount of farms that could be supported. The loss of farm labor in these areas would also negatively impact the economy. In the eastern part of England, it would be expected that horticulture would expand, and therefore, benefit the region's economy (Arnoult et al. 2008).

Citing a \$75 billion cost associated with poor diets in the U.S., Rickard and Gonsalves (2008) conducted a similar study regarding American agriculture. They suggested that one way to combat the obesity epidemic is through Americans increasing consumption of specialty crops such as fruits, vegetables, and nuts. This article evaluated seven dietary plans and how they would affect American agriculture. These seven plans were: 1) The 1992 USDA Food Guide Pyramid; 2) Harvard's Healthy Eating Pyramid; 3) The Mayo Clinic Pyramid; 4) The Traditional Mediterranean Diet Pyramid; 5) The Atkins Model; 6) Dietary Approaches to Stop Hypertension (DASH); and 7) The 2005 USDA MyPyramid.

Recommended daily intake of each macronutrient, such as protein, carbohydrates, and cholesterol, were calculated for all of the diets, based on a 2000-calorie diet. These diets were compared to the Continuing Survey of Food Intake by Individuals (CSFII) to examine how much one's diet should change in order to follow one of the recommended diets.

Results showed that for nearly all of the agricultural products tested, there would be an increase in revenues if any of these diets except the Atkins diet were strictly

followed. The Atkins diet resulted in an increase in beef, chicken, eggs, turkey, and lamb, but most specialty crops decreased. Out of the 38 agricultural products tested, the Atkins Diet would decrease the amount of average agricultural revenues by 18.7%, while Harvard's Pyramid would generate the most revenue overall by an average increase of 29.5% (Rickard and Gonsalves 2008).

Ribera, Yue and Holcomb (2010) evaluated how the 2010 Dietary Guidelines would affect agricultural production in the U.S. The 2010 Dietary Guidelines hoped to decrease calories and fats in Americans' diets. Goals of the guidelines were to increase vegetable, fruit and whole grain consumption, substituting fish and nuts for other types of meats, and substituting low-fat dairy choices for regular dairy.

Results showed that fruit availability would have to increase by 133% to satisfy the recommended amount. This would significantly impact agricultural production in California and Florida. Vegetable production would need to increase by 114%, which would have a large effect on California. The guidelines suggested reducing refined grain consumption by 29% and increasing whole grain consumption by 423%. This would not require more wheat production, but instead, a change in how the wheat is processed. The dietary guidelines recommended a 21% decrease in meat, poultry, and egg consumption. Dairy is complicated because the recommendations suggest more low-fat milk but less butter. These products cannot easily be differentiated in the analysis.

Short-run effects of the policies, assuming all Americans began to follow the guidelines, would be an increase in prices for the recommended foods and a decrease in prices for those foods that are not recommended.

CHAPTER III

METHODS AND PROCEDURES

Hypotheses

Hypothesis 1: Consumers will significantly increase their consumption of meat, dairy and eggs while on a low-carbohydrate diet.

Hypothesis 2: Consumers will moderately increase their consumption of vegetables while on a low-carbohydrate diet.

Hypothesis 3: Those with a higher BMI will be more likely to increase consumption of animal-based foods than vegetables while on a low-carbohydrate diet.

Survey

A survey of 440 people was conducted to evaluate perception of diets and nutrition. Approval was obtained from University Research Services and the Institutional Review Board (IRB) at Oklahoma State University prior to administering the survey. This study was reviewed by IRB and approved December 18, 2013. The application number assigned to this research was AG-13-57 (Appendix D).

The survey was conducted both online, using Qualtrics, and an in-person, at Mathis Brothers in Oklahoma City, OK. The in-person survey respondents, who were Mathis Brothers employees, were paid \$5 by the surveyor for completing the survey.

Basic Descriptive Statistics of the Data

Of the 440 people surveyed, 54% were female, and 46% were male. The ethnicity of the group was: 72% white, 10% African American, 8% Hispanic, 6% Asian, 2% American Indian, and 2% other (Appendix B, Figure 1). The percentages for gender for the United States as a whole as of the 2010 census were 50.8% are female and 49.2% male. Ethnicity statistics for the nation were: 64% white, 12% African American, 16% Hispanic, 5% Asian, 1% American Indian, and 2% other (U.S. Census Bureau 2014).

When asked their highest level of education, responses were: 2% no high school diploma, 37% high school diploma, 23% associate's degree, 25% bachelor's degree, and 13% graduate degree. In comparison, statistics for the nation for the population over 25 years of age are as follows: 14% no high school diploma, 28% high school diploma, 21% some college, no degree, 8% associate's degree, 18% bachelor's degree, and 11% graduate degree (U.S. Census Bureau 2014). Therefore, our group was somewhat more educated than the nation as a whole, however, our survey did not have an option to select "some college, no degree," so they are not perfectly comparable.

There was also a question about household income in the survey. Respondent's answers were as follows: 27% at \$30,000 or less; 22% between \$30,001 and \$50,000; 20% between \$50,001 and \$70,000; 14% between \$70,001 and \$90,000; 8% between \$90,001 and \$110,000; and 9% were more than \$110,000. The income brackets in the

census were not the same as they were in our study; however, comparisons to the census are: 23% at \$25,000 or less; 24% between \$25,000 and \$50,000; 18% between \$50,000 and 75,000; 12% between \$75,000 and \$100,000; and 22% were more than \$100,000 (U.S. Census Bureau 2014).

Respondents provided their height and weight. With those measures, BMI was calculated using the National Institutes of Health's (NIH) categorizations for underweight, healthy weight, overweight and obese (NIH 2014). The results for BMI were: 3% underweight, 39% healthy weight, 29% overweight, and 29% obese (Appendix B, Figure 2).

The survey focused on questions about health, nutrition and diet. When asked which food groups they regularly eat, the highest responses were vegetables and meat at 89% and 86% respectively. Conversely, only 52% said they eat sugar regularly, which made sugar the least consumed food group (Appendix B, Figure 3).

Respondents were asked if particular statements applied to their eating habits over the past year. The first statement was, "I regularly consume fewer calories than I would like, so that I don't gain weight." Twenty percent agreed with this statement. Other statements were: "I regularly choose to eat certain foods because I believe they will help me lose or maintain a healthy weight"; "I choose foods largely based on taste, convenience, and price, without worrying about weight gain"; "Other people make most of my food decisions for me"; and "Because I exercise regularly, I do not worry about what I eat." The responses to these statements were 47%, 44%, 3%, and 15% respectively (Appendix B, Figure 4). Therefore, the statement most identified with was, "I regularly

choose to eat certain foods because I believe they will help me lose or maintain a healthy weight.”

When asked if they were informed about weight loss, 63% agreed, 20% were neutral, and 17% did not feel they were informed about weight loss (Appendix B, Figure 5). The statement most agreed with when asked about effective ways to lose or maintain weight was, “Replace fats with vegetables,” at 88%. On the other hand, only 38% of respondents felt that replacing fats with carbohydrates was an effective way to lose weight (Appendix B, Figure 6). A similar question about specific diets was asked. The diets ranked in descending order of effectiveness were: more exercise, less calories, low-carbohydrate, low-fat, Weight Watchers, Mediterranean, gluten-free, and lastly Paleo (Appendix B, Figure 7). It is important to note that the statement “no experience with this diet,” was also an option, therefore, some people may not have been familiar with at least one of these diets’ effectiveness.

Those surveyed were given three options and asked which would be easiest to maintain while on a low-carbohydrate diet. The options were: 1) reduce total carbohydrates, but increase servings of meat, dairy and/or eggs; 2) reduce total carbohydrates, but increase servings of vegetables; and 3) reduce total carbohydrates, and eat the same portions of other foods. Increasing servings of vegetables was seen as the easiest to maintain with 41%, increasing servings of meat, dairy and/or eggs followed with 31%, and cutting carbohydrates and eating the same portions of other foods was least easy to maintain with 28% (Appendix B, Figure 8).

Those surveyed were asked, “When on a low-carbohydrate diet, how does your consumption of the following foods change?” The responses for which foods were eaten more were: vegetables 68%, fruits 55%, chicken/turkey 50%, yogurt 34%, eggs 29%, beef 21%, cheese 20%, milk 20%, pork 16%, and sugar 10% (Appendix B, Figure 9).

Lastly, when asked whether eating meat had an effect on losing weight, 30% said there was low impact, 44% said no impact, and 26% said high impact (Appendix B, Figure 10).

Modeling Framework

Ordered Logit Models

Questions five through 13 of the survey asked respondents to indicate the extent to which they agreed with particular statements. For example, “One can lose weight and/or maintain a healthy weight by consuming less carbs, replacing the carbs with more meat, dairy, and/or eggs.” The possible responses were: strongly disagree, disagree, somewhat disagree, neither agree nor disagree, somewhat agree, agree, and strongly agree. When running the regression, this range of opinions was used as the dependent variable which is not continuous.

For example, we can number the responses of strongly disagree to strongly agree one through seven, but we cannot say that the difference between opinion one (strongly disagree) and opinion two (disagree) is the same as the difference between opinion two (disagree) and opinion three (somewhat disagree). Therefore, an ordered logit model for opinion survey data, similar to Prickett, Norwood, and Lusk (2010), was used. The

ordered logit model allows us to analyze general attitudes toward the responses about the diets without knowing the respondent's exact attitude toward the diet.

Model 1:

$$y^* = \beta'X + \varepsilon = \beta_0 + \beta_1X_{D1} + \beta_2X_{D2} + \beta_3X_{D3} + \beta_4X_{D4} + \beta_5X_{D5} + \beta_6X_{D6} + \beta_7X_{D7} + \beta_8X_{D8} + \beta_9(X_{GF}) + \beta_{10}X_{D1}(X_{GF}) + \beta_{11}X_{D2}(X_{GF}) + \beta_{12}X_{D3}(X_{GF}) + \beta_{13}X_{D4}(X_{GF}) + \beta_{14}X_{D5}(X_{GF}) + \beta_{15}X_{D6}(X_{GF}) + \beta_{16}X_{D7}(X_{GF}) + \beta_{17}X_{D8}(X_{GF}) + \varepsilon$$

where y^* is the latent or unobserved attitude, X is a vector of diets, β is a parameter vector to be estimated and ε is a Type I Extreme Value error term. The variable GF is a dummy variable representing females. The vector of diets is as follows:

D1: Diet 1 (Less carbs, more meat, dairy and/or eggs)

D2: Diet 2 (Less carbs, more vegetables)

D3: Diet 3 (Less carbs, less calories)

D4: Diet 4 (Less calories, same foods)

D5: Diet 5 (Less fatty foods, more carbs)

D6: Diet 6 (Less fatty foods, more vegetables)

D7: Diet 7 (Less fatty foods, more low-fat meat, dairy, eggs)

D8: Diet 8 (Less fatty foods, less calories)

A second ordered logit model was tested to determine if BMI had an impact on diet perceptions. All variables remained the same as in Model 1, except the dummy variable for gender was removed, and the dummy variable for overweight BMI (*OWBMI*) was added.

Model 2:

$$\begin{aligned}
y^* = \beta' \mathbf{X} + \varepsilon &= \beta_0 + \beta_1 X_{D1} + \beta_2 X_{D2} + \beta_3 X_{D3} + \beta_4 X_{D4} + \beta_5 X_{D5} + \beta_6 X_{D6} + \beta_7 X_{D7} + \beta_8 X_{D8} + \\
&\beta_9(X_{OWBMI}) + \beta_1 X_{D1}(X_{OWBMI}) + \beta_2 X_{D2}(X_{OWBMI}) + \beta_3 X_{D3}(X_{OWBMI}) + \beta_4 X_{D4}(X_{OWBMI}) + \\
&\beta_5 X_{D5}(X_{OWBMI}) + \beta_6 X_{D6}(X_{OWBMI}) + \beta_7 X_{D7}(X_{OWBMI}) + \beta_8 X_{D8}(X_{OWBMI}) + \varepsilon
\end{aligned}$$

CHAPTER IV

RESULTS

Although some conclusions could be drawn from the descriptive statistics of the data, regression analysis was conducted to further investigate the objectives of the study. First, an ordered logit model (Model 1) was used to evaluate perceptions regarding the effectiveness of particular diets. This model used answers to survey questions five through 13 (Appendix A), which asked questions about the degree to which respondents agreed with ways to lose weight. Interaction terms were included to evaluate if gender played a role in perception of particular diets because previous research indicates that women are more likely to diet than men (Buzzacot et al. 2013).

Second, an additional ordered logit model (Model 2) was conducted to determine if individuals with overweight or obese BMI rate particular diets statistically differently than those with a healthy BMI. In this model, a dummy variable was created to categorize respondents as overweight or healthy weight. The dummy variable was interacted with each of the diets.

Regression Models

Results to Model 1 (Appendix C, Table 1.1) showed the highest rated diet was to consume less fatty foods, and replace those fatty foods with more vegetables. This is shown in the table as variable *D6*. *D6* had a coefficient of 0.9949 at the 99% confidence level. The lowest rated diet, *D5*, was to consume less fatty foods and replace the fatty foods with more carbohydrates. *D5* had a coefficient of -1.0705 at the 99% confidence level. We can conclude that respondents believe it is important to cut fats from their diet; however, carbohydrates are not a good replacement food for those fats. These results are interesting because the replacement of fatty foods with vegetables would be suggested by the Dietary Guidelines, as would the replacement of fatty foods with carbohydrates as outlined by Gray (2012). Therefore, the diet that consumers most agreed with as well as the diet that consumers least agreed with would both be recommended by the Dietary Guidelines.

Also using the results of the regression analysis, the first two objectives of the study were evaluated. The variables *D1* and *D2* were used in this analysis. Diet 1 (*D1*) was stated in the survey as, “One can lose weight and/or maintain a healthy weight by consuming less carbs, replacing the carbs with more meat, dairy, and/or eggs.” Similarly, Diet 2 (*D2*) was stated in the survey as, “One can lose weight and/or maintain a healthy weight by consuming less carbs, replacing the carbs with more vegetables.” The coefficient for males for *D1* was -0.4088 at the 95% confidence level, and *D2* was 0.5556 at the 99% confidence level. Therefore, we can determine that men rate *D2*, replacing carbohydrates with vegetables, higher than *D1*, replacing carbohydrates with meat, dairy, and/or eggs.

In order to determine the difference between how females and males rated the two diets, the coefficients from the interaction terms were added. For example, $-0.4088 + 0.4784 = 0.0696$ is the coefficient for how females rated *D1* while $0.5556 + 0.8890 = 1.4446$ is the coefficient for females' rating of *D2*. This shows that females also rated Diet 2 higher than Diet 1. Then the difference in the two coefficients for each gender was subtracted by taking $D2 - D1$ for males, and $D2 - D1$ for females and comparing those numbers. Therefore, for males we found $0.5556 + 0.4088 = 0.9644$, and for females we found $1.4446 - .0696 = 1.375$. Since the difference between *D1* and *D2* was greater for females than males, the conclusion was drawn that women prefer the diet that replaces carbohydrates with vegetables over the diet that replaces carbohydrates with meat, dairy, and/or eggs to a higher degree than men. This is similar to the finding of Feinman, Vernon, and Westman (2006) as their survey found that 53% of low-carbohydrate dieters said they increased their consumption of lettuce/salad, while only 22% increased their intake of beef, bacon, or butter. However, it contradicts Rickard and Gonsalves (2008) which said that implementation of the Atkins diet, a low-carbohydrate diet, would result in increased consumption of beef, chicken, eggs, turkey, and lamb, while the intake of most vegetables would decrease. It should be said that their analysis was done on a strict Atkins diet, and it is likely that many low-carbohydrate diets are a variation of Atkins or some other diet.

The second model, (Appendix C, Table 2.1) which used a dummy variable for those with an overweight BMI, found no statistically significant differences in the rating of diets between those who are of a healthy weight and those who are overweight or obese. This follows what Gregory, Smith, and Wendt (2011) found that whether someone

is healthy weight or overweight, most people tend to know what it takes to be healthy, the difference in the two groups is implementation of healthy practices.

CHAPTER V

CONCLUSION

Obesity-related medical costs have reached approximately \$75 billion annually in the United States (Rickard and Gonsalves 2008). Due to this, topics such as diet, nutrition, and health will continue to be ardently discussed in the private and public sectors. Many different diet methods vie for consumers' attention with any number of techniques to lose weight. One of those methods, a low-carbohydrate diet, was addressed in this research.

In this study, both summary statistics and ordered logit regressions indicated that individuals perceive substituting vegetables for carbohydrates instead of meat, dairy and/or eggs as better. This contradicted our hypotheses as it was assumed there would be a larger increase in the consumption of animal products than vegetables among those on low-carbohydrate diets. This suggests that the vegetable industry is more positively impacted than animal agriculture by the popularity of low-carbohydrate diets.

Further research could be conducted to determine causes for this preference.

Causes to be examined could be: 1) personal experience with replacing vegetables for

carbohydrates; 2) the perception that vegetables are a less expensive substitute for carbohydrates than meat, dairy, and/or eggs; 3) vegetables have been promoted by doctors, dieticians, or others who are an authority on nutrition; 4) marketing by vegetable groups has influenced the populace; or 5) public policies such as additional specialty crop funding in the Farm Bill, or the Dietary Guidelines emphasis on vegetables have influenced the public's view of the superiority of vegetables.

An additional finding of the study was that BMI did not have a significant impact on perceptions of diets. This could be explained by the fact that although someone might be overweight, they have the same perceptions of how to be healthy as someone who is of a healthy weight.

Agricultural advocacy groups should be constantly reevaluating the public's perception about the nutrition of the food or food groups they promote. For example, when a new diet focuses on the importance of increasing or decreasing one of the macronutrients, protein, fats, or carbohydrates, marketing campaigns should be able to express to the public the merits of what their food or food group has to offer to coincide with that diet. This will allow the most effective marketing strategies to not only help support agriculture, but to also help consumers in their quest for healthier lifestyles.

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APPENDICES

APPENDIX A

SURVEY

Preferences for food in weight control

The purpose of this survey is to learn about consumer food preferences, including beliefs about the relationship between certain foods and health. Please answer all questions honestly, and to the best of your ability. Remember that your answers will be kept strictly confidential, and that you may stop taking the survey at any time. For any questions or concerns please contact Bailey Norwood at bailey.norwood@okstate.edu or 405-334-0010.

FIRST, PLEASE TELL US ABOUT YOUR EATING AND EXERCISE HABITS.

1. Which of the following best describes your exercise habits in the last year?

Although you may identify with multiple statements, please select the ONE statement that best describes you. In these statements, "regular exercise" refers to 30 minutes of exercise per day, on average.

- I do NOT exercise regularly
- I exercise regularly to lose weight
- I exercise regularly to prevent weight gain
- I exercise regularly to build muscle
- I exercise regularly for other health reasons (for example, lowering bad cholesterol levels)
- I exercise regularly because I enjoy it
- I exercise regularly so that I do not have to diet
- I exercise regularly for other reasons

2. Please check ALL statements that describe your eating habits in the last year.

- I regularly consume fewer calories than I would like, so that I don't gain weight
- I regularly choose to eat certain foods because I believe they will help me lose weight or maintain a healthy weight
- I choose foods largely based on taste, convenience, and price, without worrying about weight gain
- Other people make most of my food decisions for me
- Because I exercise regularly, I do not worry about what I eat

PLEASE INDICATE THE EXTENT TO WHICH YOU AGREE OR DISAGREE WITH THE FOLLOWING STATEMENTS.

3. I consider myself very informed about the different weight-loss strategies and their effectiveness

- Strongly Disagree
- Disagree
- Somewhat Disagree
- Neither Agree nor Disagree
- Somewhat Agree
- Agree
- Strongly Agree

4. Friends and family rely on me for suggestions about losing weight and maintaining a healthy weight.

- Strongly Disagree
- Disagree
- Somewhat Disagree
- Neither Agree nor Disagree
- Somewhat Agree
- Agree
- Strongly Agree

PLEASE INDICATE THE EXTENT TO WHICH YOU AGREE OR DISAGREE WITH THE FOLLOWING STATEMENTS.

(Please note that throughout the survey, "carbs" refer to simple carbohydrates, like sugar, and complex carbohydrates, like whole wheat bread. However, one may assume that a "low-carb" diet concentrates more on reducing intake of simple carbohydrates.)

5. One can lose weight and/or maintain a healthy weight by consuming less carbs, replacing the carbs with more meat, dairy, and/or eggs.

- Strongly Disagree
- Disagree
- Somewhat Disagree
- Neither Agree nor Disagree
- Somewhat Agree
- Agree
- Strongly Agree

6. One can lose weight and/or maintain a healthy weight by consuming less carbs, replacing the carbs with more vegetables.

- Strongly Disagree
- Disagree
- Somewhat Disagree
- Neither Agree nor Disagree
- Somewhat Agree
- Agree
- Strongly Agree

7. One can lose weight and/or maintain a healthy weight by consuming less carbs AND consuming less calories.

- Strongly Disagree
- Disagree
- Somewhat Disagree
- Neither Agree nor Disagree
- Somewhat Agree
- Agree
- Strongly Agree

8. One can lose weight and/or maintain a healthy weight by consuming less calories, but eating the same types of foods.

- Strongly Disagree
- Disagree
- Somewhat Disagree
- Neither Agree nor Disagree
- Somewhat Agree
- Agree
- Strongly Agree

9. One can lose weight and/or maintain a healthy weight by consuming less fatty foods, replacing the fatty foods with more carbs.

- Strongly Disagree
- Disagree
- Somewhat Disagree
- Neither Agree nor Disagree
- Somewhat Agree
- Agree
- Strongly Agree

10. One can lose weight and/or maintain a healthy weight by consuming less fatty foods, replacing the fatty foods with more vegetables.

- Strongly Disagree
- Disagree
- Somewhat Disagree
- Neither Agree nor Disagree
- Somewhat Agree
- Agree
- Strongly Agree

11. One can lose weight and/or maintain a healthy weight by consuming less fatty foods, replacing the fatty foods with low-fat meat, dairy, and/or eggs.

- Strongly Disagree
- Disagree
- Somewhat Disagree
- Neither Agree nor Disagree
- Somewhat Agree
- Agree
- Strongly Agree

12. One can lose weight and/or maintain a healthy weight by consuming less fatty foods AND consuming less calories.

- Strongly Disagree
- Disagree
- Somewhat Disagree
- Neither Agree nor Disagree
- Somewhat Agree
- Agree
- Strongly Agree

13. One can lose weight and/or maintain a healthy weight by eating the same kinds and amounts of food, but exercising more.

- Strongly Disagree
- Disagree
- Somewhat Disagree
- Neither Agree nor Disagree
- Somewhat Agree
- Agree
- Strongly Agree

DIRECTIONS

Questions 14 – 17 ask you to rank diets according to specific criteria. If there are four diets, rank the diets you put the number 1, 2, 3, or 4 next to each type of diet. Each diet should receive a unique ranking (for instance, the number “1” should be assigned to one and only one diet) and no blank should be left empty (meaning all four numbers should be assigned to a diet). In the example below, Diet B most closely meets the criteria, so it receives a ranking of 1, and because Diet C least closely meets the criteria it receives a ranking of 4.

 3 Diet A

 1 Diet B

 4 Diet C

 3 Diet D

14. In your opinion, how effective are each of the following diets for losing weight and/or maintaining a healthy weight, if one can maintain them for months? Rank them according to their effectiveness (1 = most effective and 4 = least effective).

 Low-carb diet

 Low-fat diet

 More exercise

 Reduce calories of all foods by the same proportion

15. In your opinion, how easy is it to maintain each of the following diets? Rank them according to their ease (1 = easiest to maintain and 4 = most difficult to maintain).

_____ Low-carb diet

_____ Low-fat diet

_____ More exercise

_____ Reduce calories of all foods by the same proportion

16. In your opinion, how effective are each of the following LOW-CARB diets for losing weight and/or maintaining a healthy weight, if one can maintain them for months? Rank them according to their effectiveness (1 = most effective and 4 = least effective).

_____ Reduce total carbs but increase servings of meat, dairy, and, or eggs

_____ Reduce total carbs but increase servings of vegetables

_____ Reduce total carbs and eat same portions of other foods

17. In your opinion, how easy is it to maintain each of the following diets? Rank them according to their ease (1 = easiest to maintain and 4 = most difficult to maintain).

_____ Reduce total carbs but increase servings of meat, dairy, and, or eggs

_____ Reduce total carbs but increase servings of vegetables

_____ Reduce total carbs and eat same portions of other foods

18. In your opinion, how does increasing one's meat consumption impact the likelihood of the following health consequences?

	Less likely	No change	More likely
Losing weight	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Living longer	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Diabetes	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Heart (cardiovascular) disease	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Cancer	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
High cholesterol	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Becoming stronger	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Becoming smarter	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Food sickness	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Depression	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

19. Have you lost weight in the last two years?

- Yes
 No

IF YOU ANSWERED "YES" TO THE QUESTION ABOVE PLEASE SKIP TO QUESTION 21.

20. Have you maintained a healthy weight in the last two years?

- Yes
 No

IF YOU ANSWERED "NO" TO THE QUESTION ABOVE PLEASE SKIP TO QUESTION 28.

21. Which of the following strategies have been most effective for YOU in losing weight and/or maintaining a healthy weight?

	No experience with this diet	Very ineffective	Ineffective	Effective	Very effective
Low-carb diet	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Low-fat diet	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Consuming less calories	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Exercising more	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Gluten-free diet	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Paleo diet	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Mediterranean diet	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Weight Watchers	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Other diet(s)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

IF YOU ANSWERED "NO EXPERIENCE WITH THIS DIET" CORRESPONDING TO THE LOW-CARB DIET PLEASE SKIP TO QUESTION 28.

22. When you are on a low-carb diet, how does your consumption of the following foods change?

	Consume less of	Consume the same amount of	Consume more of
Beef	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Pork	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Chicken / Turkey	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Milk	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Yogurt	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Cheese	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Eggs	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Vegetables	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Sugar (excluding those found naturally in fruits)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Fruits	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

PLEASE INDICATE THE EXTENT TO WHICH YOU AGREE OR DISAGREE WITH THE FOLLOWING STATEMENTS.

23. The next time I attempt to lose weight I will use a low-carb diet.

- Strongly Disagree
- Disagree
- Somewhat Disagree
- Neither Agree nor Disagree
- Somewhat Agree
- Agree
- Strongly Agree

24. Low-carb diets are just a fad. In ten years very few people will use it.

- Strongly Disagree
- Disagree
- Somewhat Disagree
- Neither Agree nor Disagree
- Somewhat Agree
- Agree
- Strongly Agree

25. Meat, dairy, and/or eggs allow me to lose weight and/or maintain a healthy weight while still feeling full after meals.

- Strongly Disagree
- Disagree
- Somewhat Disagree
- Neither Agree nor Disagree
- Somewhat Agree
- Agree
- Strongly Agree

26. Meat, dairy, and/or eggs allow me to lose weight and/or maintain a healthy weight without spending more money for food.

- Strongly Disagree
- Disagree
- Somewhat Disagree
- Neither Agree nor Disagree
- Somewhat Agree
- Agree
- Strongly Agree

27. Meat, dairy, and/or eggs allow me to lose weight and/or maintain a healthy weight while still eating foods I like.

- Strongly Disagree
- Disagree
- Somewhat Disagree
- Neither Agree nor Disagree
- Somewhat Agree
- Agree
- Strongly Agree

FINALLY, PLEASE TELL US A FEW THINGS ABOUT YOURSELF, AND REMEMBER YOUR ANSWERS ARE CONFIDENTIAL.

28 What is your gender?

- Female
- Male

29. What is your annual (pre-tax) household income (income from all earners who reside at your house)?

- \$30,000 or less
- \$30,001 to \$50,000
- \$50,001 to \$70,000
- \$70,001 to \$90,000
- \$90,001 to \$110,000
- more than \$110,000

30. How many people reside in your household (including all ages)?

- 1
- 2
- 3
- 4
- 5
- 6
- more than 6

31. Are you responsible for buying food and/or cooking for others on a regular basis (like a spouse or child)?

- Yes
- No

32. Which of the following best describes your race or ethnicity? Please check all that apply to you

- American Indian or Alaska Native
- Asian
- Black or African American
- Hispanic
- Native Hawaiian
- Other Pacific Islander
- White
- Other

33. Please check ALL foods which you eat on a regular basis.

- Meat
- Milk
- Yogurt and/or cheese
- Eggs
- Vegetables
- Fruits
- Grains
- Sugar (excluding sugar found naturally in fruits)

34. Are you a vegan or vegetarian?

- No
- I am a vegetarian
- I am a vegan
- I am a flexitarian

35. What is your weight? _____ lbs

36. What is your height? _____ feet and _____ inches

**37. In the last two years, have you experienced any of the following health problems?
Please check all that apply.**

- Heart (cardiovascular) disease
- High blood pressure
- Stroke
- Type 1 Diabetes
- Type 2 Diabetes
- Cancer
- Gallbladder disease and/or gallstones
- Osteoarthritis
- Gout
- Breathing and/or sleep problems
- Depression
- High cholesterol
- None of these

38. What is your age?

- less than 18
- 18-24
- 25-34
- 35-44
- 45-54
- 55-64
- 65 or older

39. What is your highest level of education?

- No high school diploma
- high school diploma
- associate's degree
- bachelor's degree
- graduate degree

APPENDIX B

FIGURES

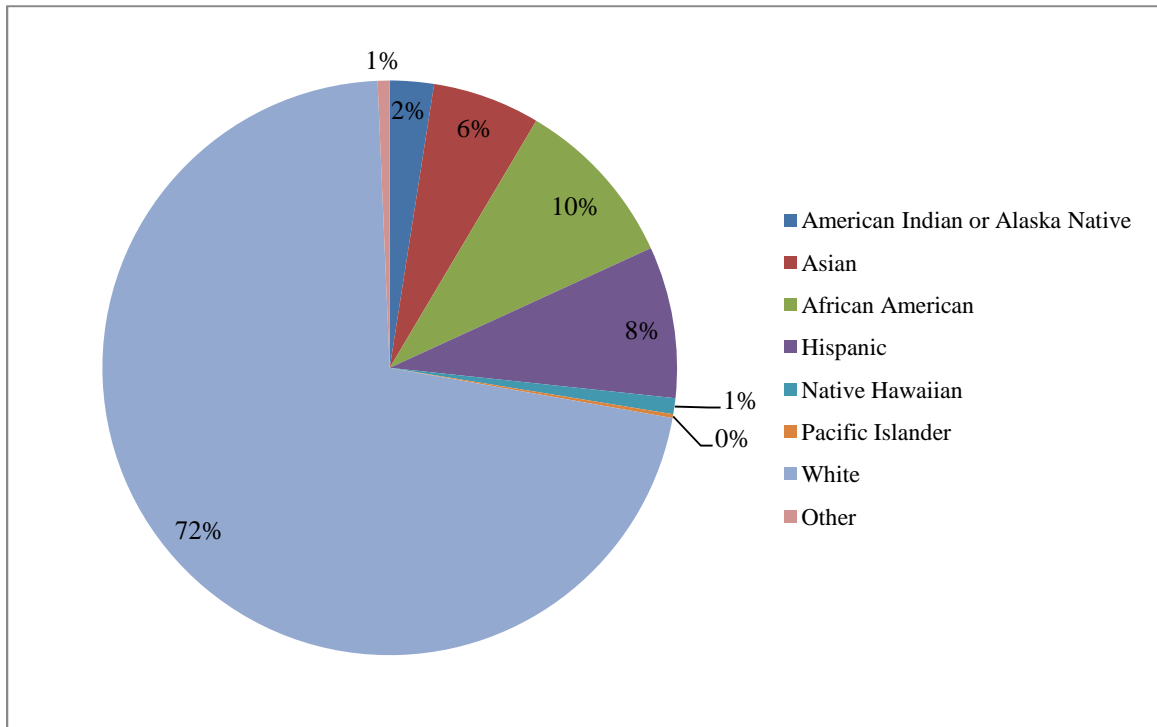


Figure 1. Ethnicity.

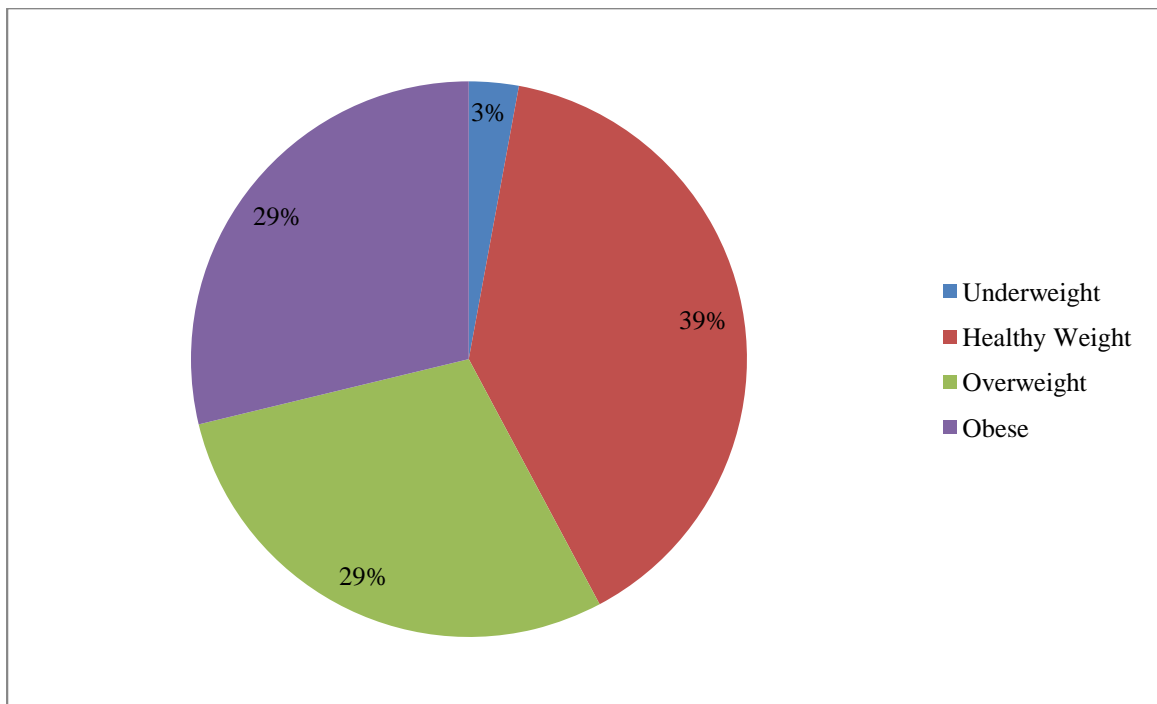


Figure 2. Body Mass Index.

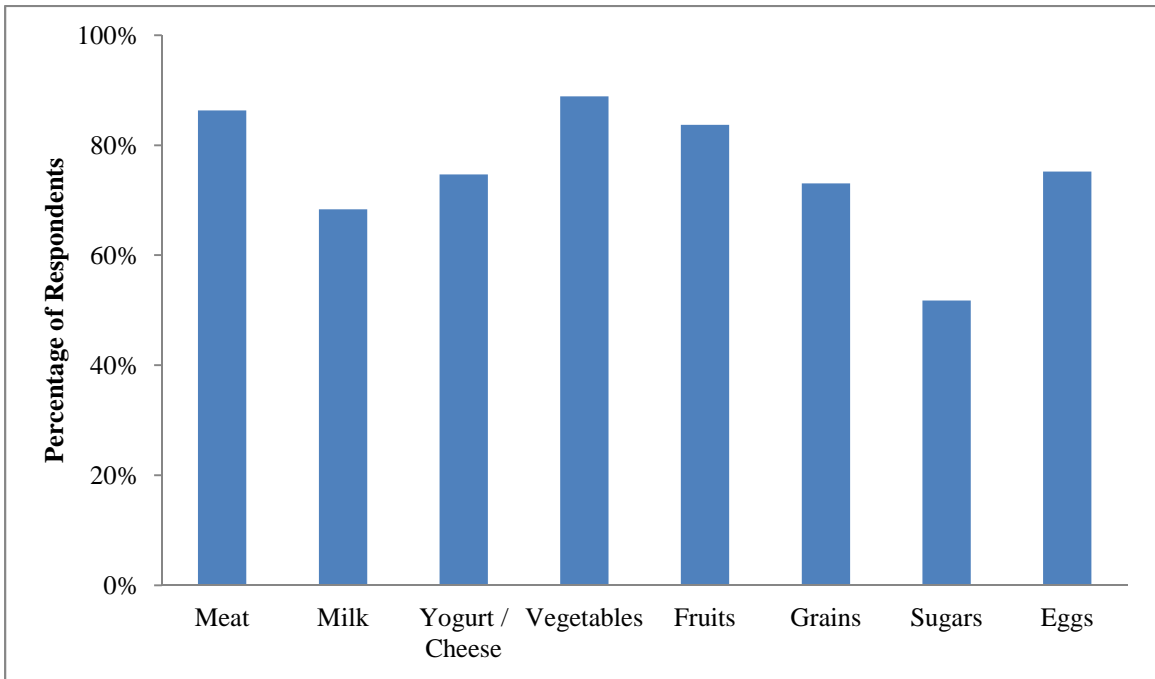


Figure 3. Foods Eaten Regularly.

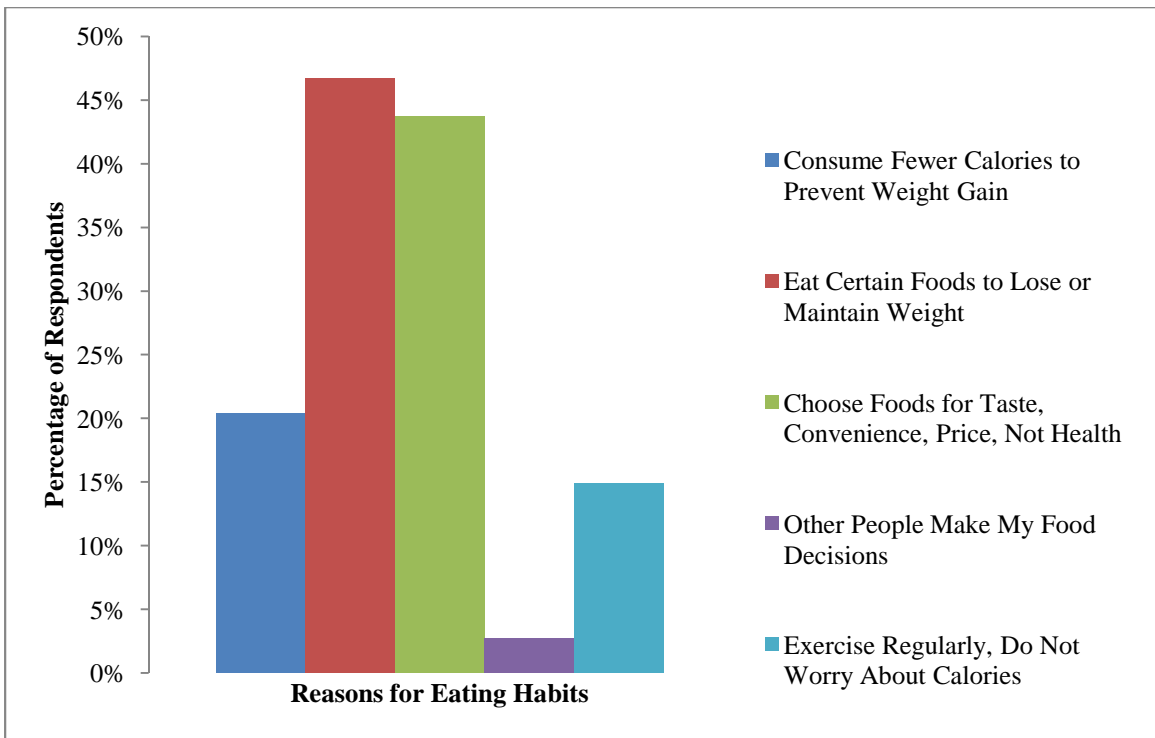


Figure 4. Eating habits.

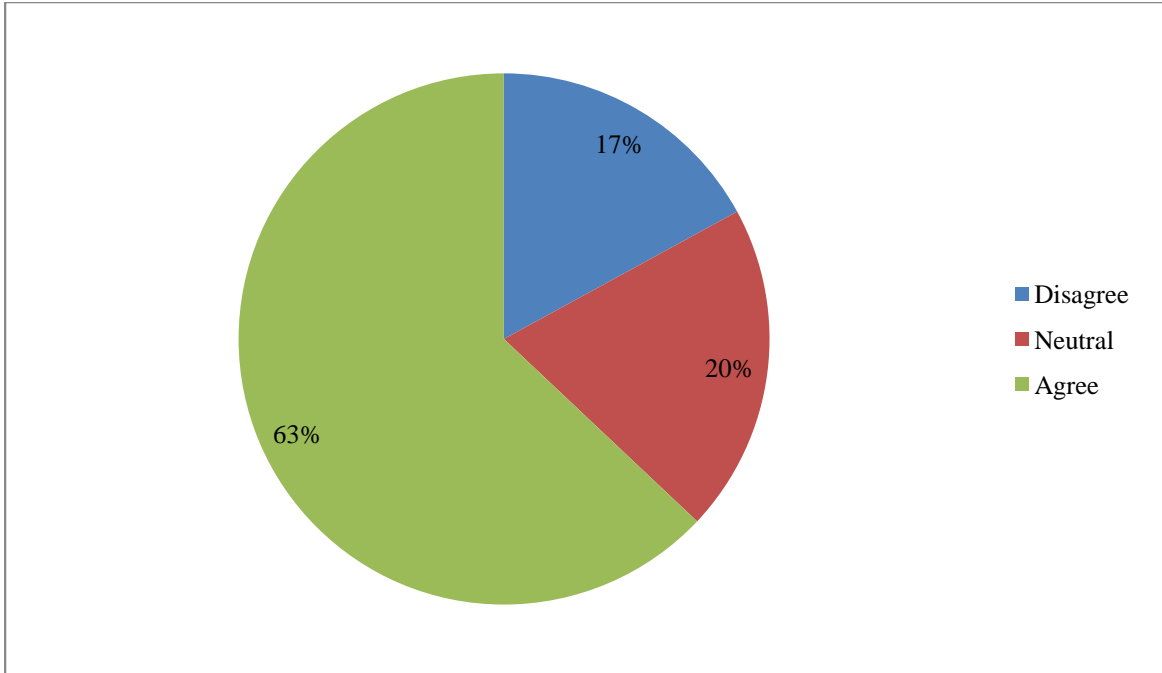


Figure 5. Are you informed about weight loss?

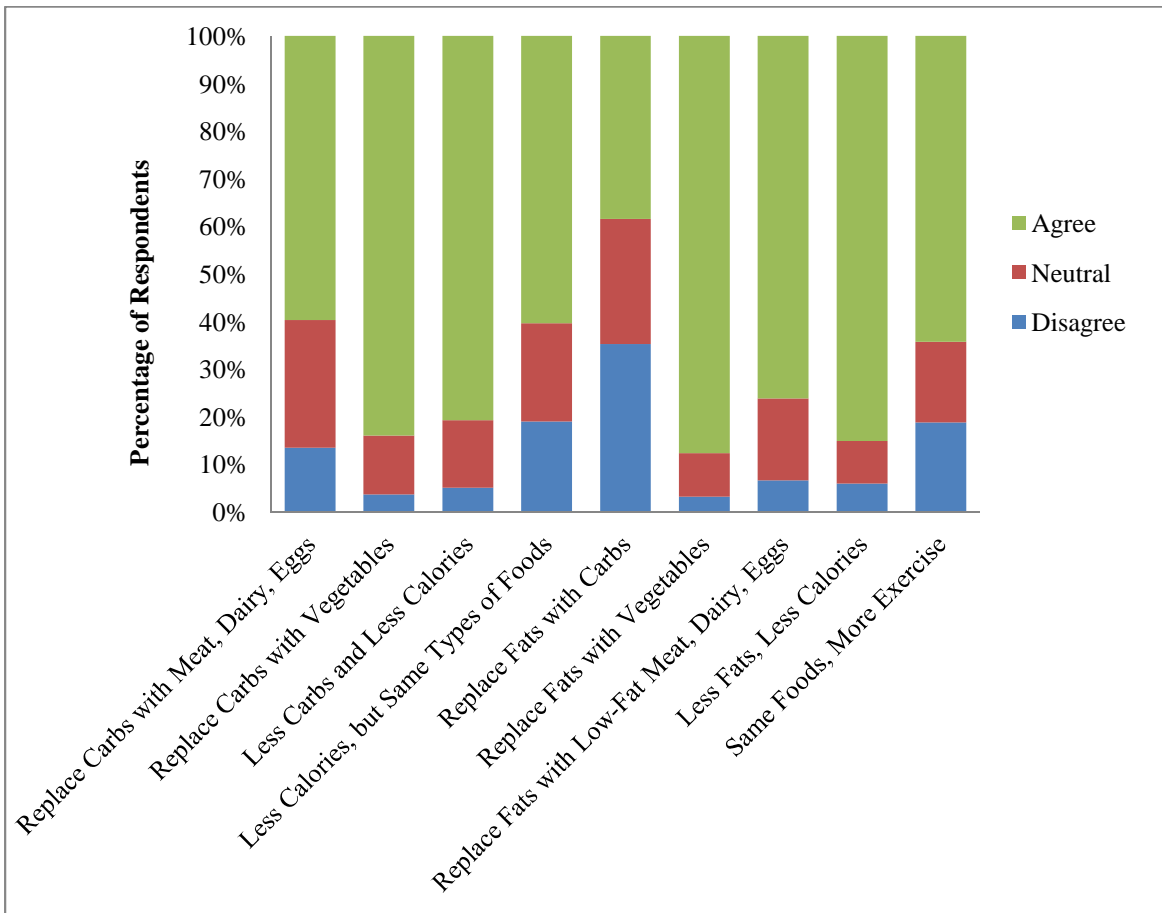


Figure 6. Effective Way to Lose or Maintain Weight.

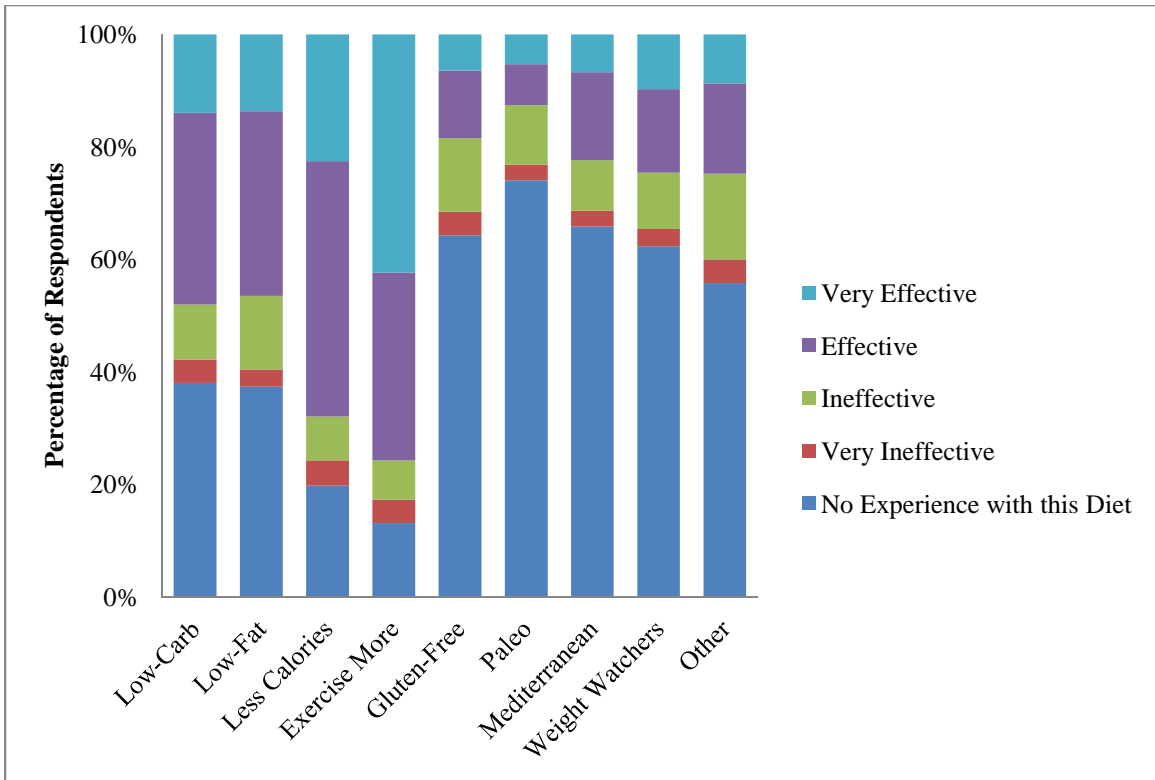


Figure 7. Effective Diet for Losing/Maintaining Weight.

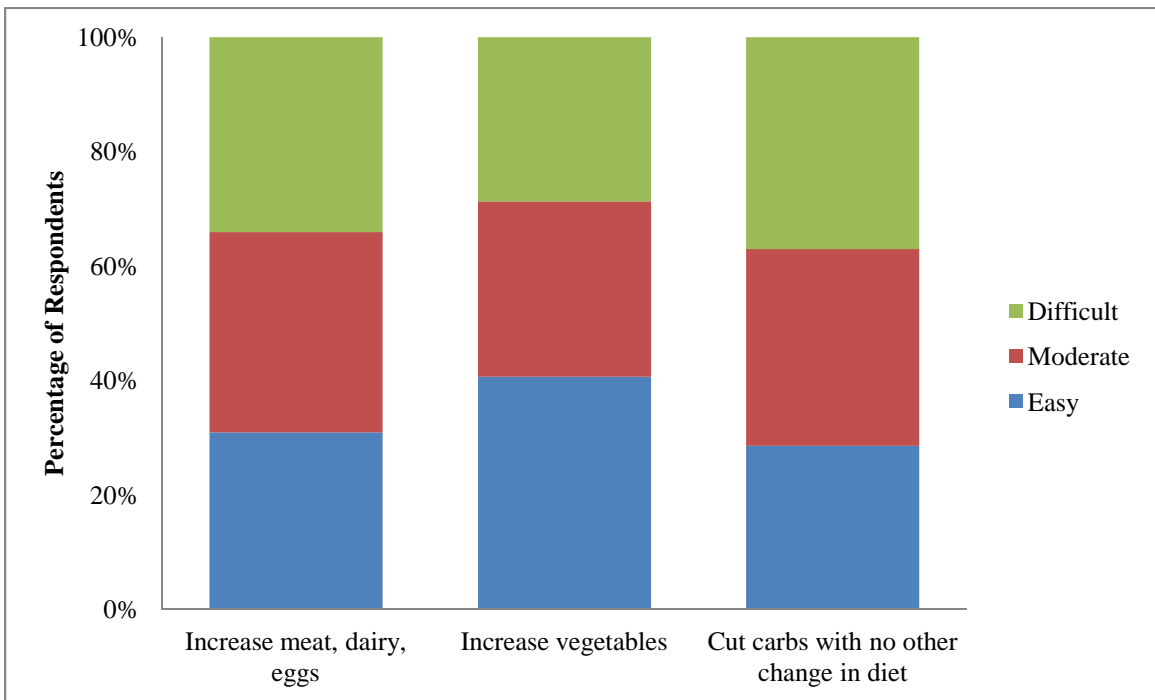


Figure 8. When dieting, which carbohydrate substitute is easiest to maintain?

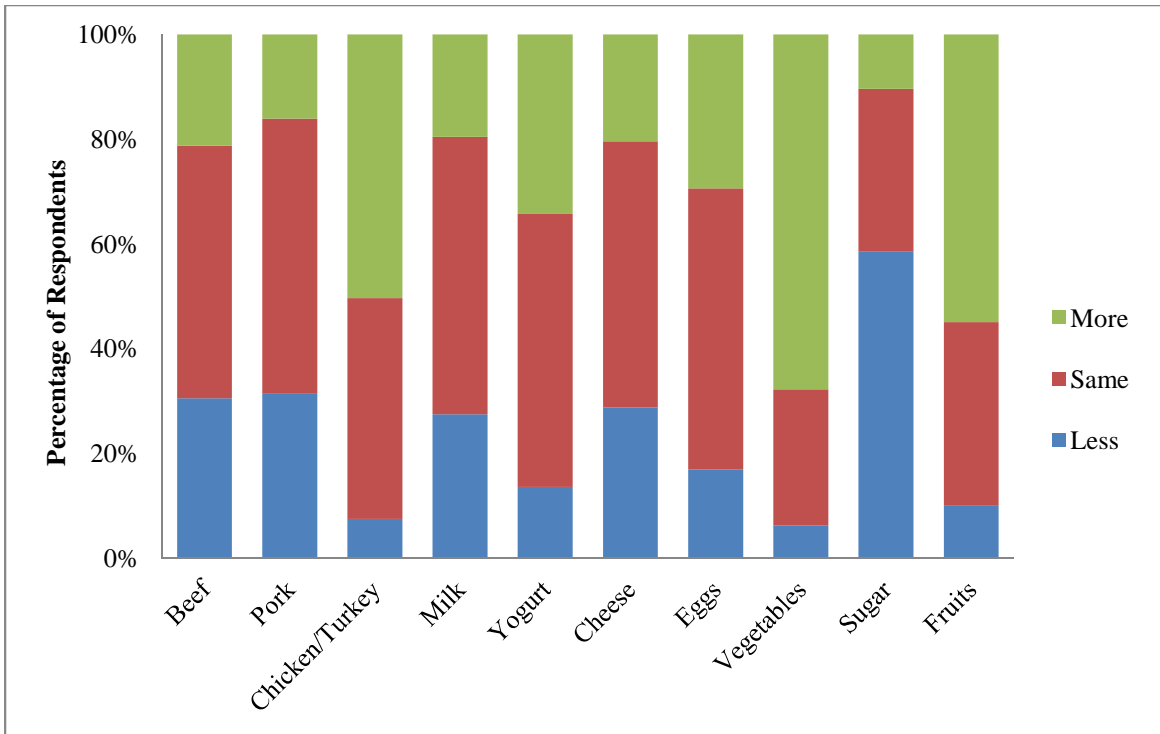


Figure 9. Consumption Change When on a Low-Carbohydrate Diet.

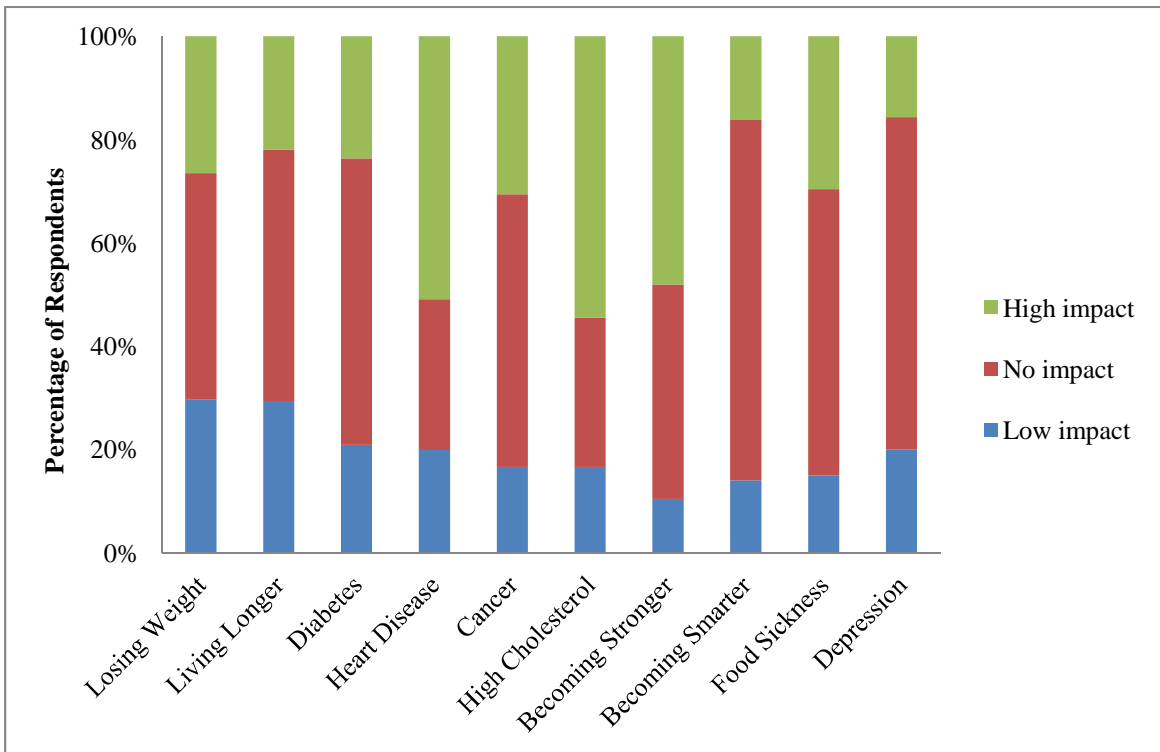


Figure 10. Increased Meat Consumption's Impact on Health.

APPENDIX C

TABLES

Table 1.1 Ordered Logit Regression of Diet Preferences Based on Gender

Diet	Coefficient	S.E.
Intercept 7	-2.1097	0.1369***
Intercept 6	-0.4810	0.1314***
Intercept 5	0.8023	0.1320***
Intercept 4	1.9857	0.1372***
Intercept 3	3.0293	0.1490***
Intercept 2	4.2927	0.1861***
Intercept 1	7.6653	0.7193***
D1	-0.4088	0.1840**
D2	0.5556	0.1849***
D3	0.3920	0.1846**
D4	-0.3827	0.1840**
D5	-1.0705	0.1844***
D6	0.9949	0.1860***
D7	0.1267	0.1842
D8	0.5780	0.1849***
GF	-0.3321	0.1763*
D1 (GF)	0.4784	0.2491*
D2 (GF)	0.8890	0.2510***
D3 (GF)	0.7754	0.2504***
D4 (GF)	0.3625	0.2490
D5 (GF)	-0.0969	0.2485
D6 (GF)	0.5781	0.2514**
D7 (GF)	0.5932	0.2498**
D8 (GF)	0.8821	0.2510***

*, **, and ***, indicate statistically significant results at the .10, .05, and .01 levels respectively

Table 1.2 Description of Independent Variables Used in Model 1

Variable	Description
D1	Diet 1 (Less carbs, more meat, dairy and/or eggs)
D2	Diet 2 (Less carbs, more vegetables)
D3	Diet 3 (Less carbs, less calories)
D4	Diet 4 (Less calories, same foods)
D5	Diet 5 (Less fatty foods, more carbs)
D6	Diet 6 (Less fatty foods, more vegetables)
D7	Diet 7 (Less fatty foods, more low-fat meat, dairy, eggs)
D8	Diet 8 (Less fatty foods, less calories)
GF	How females rated the all diets with respect to males
D1 (GF)	How females rated Diet 1 with respect to males
D2 (GF)	How females rated Diet 2 with respect to males
D3 (GF)	How females rated Diet 3 with respect to males
D4 (GF)	How females rated Diet 4 with respect to healthy males
D5 (GF)	How females rated Diet 5 with respect to males
D6 (GF)	How females rated Diet 6 with respect to males
D7 (GF)	How females rated Diet 7 with respect to males
D8 (GF)	How females rated Diet 8 with respect to males

Table 2.1 Ordered Logit Regression of Diet Preferences Based on BMI

Diet	Coefficient	S.E.
Intercept 7	-2.3031	0.1406***
Intercept 6	-0.6875	0.1351***
Intercept 5	0.5906	0.1349***
Intercept 4	1.7720	0.1396***
Intercept 3	2.8125	0.1510***
Intercept 2	4.0738	0.1876***
Intercept 1	7.4455	0.7197***
D1	-0.3213	0.1887*
D2	1.1847	0.1911***
D3	0.6866	0.1898***
D4	-0.3356	0.1887*
D5	-1.0699	0.1893***
D6	1.3324	0.1916***
D7	0.4037	0.1893**
D8	1.0709	0.1907***
OWBMI	0.0519	0.1771
D1(OWBMI)	0.2968	0.2503
D2(OWBMI)	-0.2667	0.2520
D3(OWBMI)	0.2023	0.2514
D4(OWBMI)	0.2616	0.2503
D5(OWBMI)	-0.0864	0.2497
D6(OWBMI)	-0.0535	0.2526
D7(OWBMI)	0.0700	0.2509
D8(OWBMI)	-0.0466	0.2519

*, **, and ***, indicate statistically significant results at the .10, .05, and .01 levels respectively

Table 2.2 Description of Independent Variables Used in Model 2

Variable	Description
D1	Diet 1 (Less carbs, more meat, dairy and/or eggs)
D2	Diet 2 (Less carbs, more vegetables)
D3	Diet 3 (Less carbs, less calories)
D4	Diet 4 (Less calories, same foods)
D5	Diet 5 (Less fatty foods, more carbs)
D6	Diet 6 (Less fatty foods, more vegetables)
D7	Diet 7 (Less fatty foods, more low-fat meat, dairy, eggs)
D8	Diet 8 (Less fatty foods, less calories)
OWBMI	How overweight rated the all diets with respect to healthy weight
D1 (OWBMI)	How overweight rated Diet 1 with respect to healthy weight
D2 (OWBMI)	How overweight rated Diet 2 with respect to healthy weight
D3 (OWBMI)	How overweight rated Diet 3 with respect to healthy weight
D4 (OWBMI)	How overweight rated Diet 4 with respect to healthy weight
D5 (OWBMI)	How overweight rated Diet 5 with respect to healthy weight
D6 (OWBMI)	How overweight rated Diet 6 with respect to healthy weight
D7 (OWBMI)	How overweight rated Diet 7 with respect to healthy weight
D8 (OWBMI)	How overweight rated Diet 8 with respect to healthy weight

APPENDIX D

Oklahoma State University Institutional Review Board

Date: Wednesday, December 18, 2013
IRB Application No: AG1357
Proposal Title: The role of meat, dairy, and eggs in the low-carb diets of Americans

Reviewed and Processed as: Exempt

Status Recommended by Reviewer(s): Approved Protocol Expires: 12/17/2016

Principal Investigator(s):

F. Bailey Norwood
426 Ag Hall
Stillwater, OK 74078

Kate Rose Smithson
415 Ag Hall
Stillwater, OK 74078

The IRB application referenced above has been approved. It is the judgment of the reviewers that the rights and welfare of individuals who may be asked to participate in this study will be respected, and that the research will be conducted in a manner consistent with the IRB requirements as outlined in section 45 CFR 46.

- The final versions of any printed recruitment, consent and assent documents bearing the IRB approval stamp are attached to this letter. These are the versions that must be used during the study.

As Principal Investigator, it is your responsibility to do the following:

1. Conduct this study exactly as it has been approved. Any modifications to the research protocol must be submitted with the appropriate signatures for IRB approval. Protocol modifications requiring approval may include changes to the title, PI, advisor, funding status or sponsor, subject population composition or size, recruitment, inclusion/exclusion criteria, research site, research procedures and consent/assent process or forms.
2. Submit a request for continuation if the study extends beyond the approval period of one calendar year. This continuation must receive IRB review and approval before the research can continue.
3. Report any adverse events to the IRB Chair promptly. Adverse events are those which are unanticipated and impact the subjects during the course of this research; and
4. Notify the IRB office in writing when your research project is complete.

Please note that approved protocols are subject to monitoring by the IRB and that the IRB office has the authority to inspect research records associated with this protocol at any time. If you have questions about the IRB procedures or need any assistance from the Board, please contact Dawnett Watkins 219 Cordell North (phone: 405-744-5700, dawnett.watkins@okstate.edu).

Sincerely,



Shelia Kennison, Chair
Institutional Review Board

VITA

Brianna Adair Domnick

Candidate for the Degree of

Master of Science

Thesis: WHICH AGRICULTURAL SECTORS BENEFIT FROM THE LOW-CARBOHYDRATE DIET MOVEMENT: A SURVEY OF CONSUMER PERCEPTIONS OF HEALTHY FOOD SUBSTITUTES ON A LOW-CARBOHYDRATE DIET

Major Field: Agricultural Economics

Biographical:

Education:

Completed the requirements for the Master of Science in Agricultural Economics at Oklahoma State University, Stillwater, Oklahoma in December, 2014.

Completed the requirements for the Bachelor of Science in Agricultural Economics at Oklahoma State University, Stillwater, Oklahoma in May, 2009.

Experience:

Teaching Assistant, AGEC 4343/5343, August 2013-December 2013
Research Assistant, Dr. Jody Campiche, January 2014- August 2014