IS IT TIME TO REEVALUATE OUR DIETARY FAT RECOMMENDATIONS?

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Is it Time to Reevaluate Our Dietary Fat Recommendations?

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The Supervisory Committee certifies that this ***disquisition*** complies with North Dakota State University's regulations and meets the accepted standards for the degree of

MASTER OF SCIENCE

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ABSTRACT

Despite Dietary Guidelines for Americans (DGAs) focus on decreased fat intake, coronary heart disease remains the leading cause of death in the United States. Consumer-confusion regarding fat-recommendations in response to these guidelines may be related to health educator (e.g. RDN) mixed-messaging. A random sample of RDNs (n=281), completed an online-survey targeting perceptions, knowledge, and dietary patterns regarding fat. Survey responses provided insights such as: 70% of RDNs strongly-agree olive oil should be regularly-utilized, 99% agree omega-3 fatty acids promote health, and 69% believe it is important to consider fat when choosing foods. Additionally, 40% of RDNs "rarely"/"never" recommend fish-oil supplements and 46% "rarely"/"never" use fat-free/reduced-fat products. Regarding confidence of fat's effect on health, 19% were "neutral"/"unsure" of polyunsaturated fatty-acids. Of the RDNs surveyed, 22% agreed recent changes in DGAs decreased their confidence making fat-recommendations. Results indicate importance of science-based fat-recommendations in relation to RDN recommendations.

Keywords: Registered Dietitian Nutritionists (RDNs), dietary fat intake, nutritional knowledge, dietary patterns, recommendations

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Eicosapentaenoic acid (EPA) .....is one of the several omega-3 (n-3) fatty acids. Intake of EPA is typically from fatty fish or fish oil supplements along with docosahexaenoic acid (DHA) (AHA, 2015b).

Coronary heart disease (CHD) .....is also known as coronary artery disease (CAD), and is the most common type of heart disease. CHD begins with plaque build-up in the heart's arteries; a condition called atherosclerosis. As the arteries narrow, it becomes more difficult for blood to flow to the heart. Heart attack or angina (chest pain) may occur as blood flow becomes reduced or blocked (AHA, 2015b).

Cholesterol .....is a waxy substance that is found among the lipids in the bloodstream and in all body cells. The two most common forms of cholesterol are high-density lipoprotein and low-density lipoprotein. Dietary intake of cholesterol is only through animal-based foods (AHA, 2015b).

Docosahexaenoic acid (DHA)
and Eicosapeneaenoic acid (EPA).....are fatty acids forming omega-3 (n-3) fatty acids. Consumption of DHA is typically from fatty fish or fish oil supplements along with EPA (AHA, 2015b).

High-density lipoprotein (HDL).....is referred to as "good" cholesterol because higher levels are associated with heart health (AHA, 2015b).

Low-density lipoprotein (LDL).....is considered "bad" cholesterol because higher levels in the bloodstream contribute to build-up in the artery walls leading to the heart. Along with other substances, it forms plaque decreasing mobility of blood within arteries and increasing of atherosclerosis risk (AHA, 2015b).

Poly-unsaturated fatty acids (PUFAs).....are a form of dietary fat that are suspected to help lower blood cholesterol levels when replacing SFAs. Examples of PUFAs include corn, safflower, sunflower, and soybean oils. PUFAs are also found in seeds and fish (AHA, 2015b).

Mono-unsaturated fatty acids (MUFAs).....are dietary fats that are associated with lowered LDL cholesterol levels, reducing heart disease and stroke risk. Examples of MUFAs are olive, canola, peanut, safflower, and sesame oil, and fatty fish (AHA, 2014c).

Omega-3 fatty acids (n-3).....are a type of PUFA and essential fat that have been shown to benefit heart health. Increased intakes of omega-3's are associated with decreased arrhythmias (abnormal heartbeats) and triglyceride levels, slow growth rate of atherosclerotic plaque, and lower blood pressure. EPA and DHA are long chain n-3 fatty acids found in seafood. Examples of n-3 sources include fatty fish such as, salmon, tuna, sardines, mackerel or shellfish and walnuts, edamame, flaxseed, canola and sesame oil (AHA, 2015b).

Omega-6 fatty acids (n-6).....are essential fats that play a crucial role in brain function and normal growth and development. Excess n-6 fatty acids promote inflammation in the body. Examples of n-6 sources are safflower, grapeseed, sunflower oil, and soybean oil (Hariss et al., 2015).

Saturated fatty acids (SFAs).....are found primarily in animal-based foods and beverages. SFAs can raise cholesterol levels in the blood. Examples of SFAs include hydrogenated oils, butter, and animal fats (AHA, 2015b).

Trans fatty acids.....are formed when vegetable oil is partially hydrogenated to a solid form. Trans fatty acids are used to extend shelf life and to give processed foods a desired taste and texture. Consumption of trans fatty acids is suspected to raise LDL cholesterol and lower HDL cholesterol (AHA, 2015b).

Triacylglycerols (TAGs).....are the most dominant form of fat in food and in the body. TAGs (otherwise known as triglycerides) can be formed in the body from other sources like carbohydrates or come from fats eaten in foods. Calories that are not utilized immediately are converted to TAGs stored by the body as an energy source to be used when needed. Release of TAG is regulated by hormones (AHA, 2015b).

CHAPTER 1. INTRODUCTION

In 1980 when the first United States (U.S.) dietary recommendations were released, avoidance of too much fat, saturated fatty acids (SFAs), and cholesterol was suggested (U.S. Department of Agriculture [USDA] and U.S. Department of Health and Human Services [HHS], 1980). These guidelines indicated consumption of excess SFA and cholesterol would increase serum cholesterol levels in most people. However, this reaction was supposed to vary due to heredity and individual response to cholesterol (USDA; HHS, 1980). These recommendations were proposed because coronary heart disease (CHD) was the leading cause of death in the U.S. at the time (Centers for Disease Control and Prevention [CDC], 2010). However, conclusive nutritional data to justify recommendations was lacking when these guidelines were released (Harcombe et al., 2015; Park, 2015).

After the 1980 Dietary Guidelines for Americans (DGA) were released, fat consumption significantly decreased throughout the U.S. In 1960, U.S. individuals consumed approximately 45 % of calories from fat. However, by 1995 dietary fat consumption was reduced to about 35 % of caloric intake (USDA Center for Nutrition Policy and Promotion, 1998; Flegal et al., 1998, & Aubert et al., 1995). Despite decreased fat intake, CHD was and still is the leading cause of death in the U.S. for both men and women. Other risk factors for CHD have increased, such as obesity and overweight, and type 2 diabetes. Roughly 13 % of adults were obese and less than one % had type 2 diabetes related to obesity in 1960; however, more recently 35.1 % of adults are obese and 9.3 % have type 2 diabetes (Flegal, Carrol, Ogden, and Curtin, 2010; CDC, 2014a). With this in mind, revisiting the current dietary fat recommendations and

evaluating new research regarding dietary fat is essential to assess reliability of current-proposed dietary recommendations.

Statement of the Problem

Confusion regarding dietary fat recommendations among adults may be contributing to increased prevalence of obesity, CHD, and type 2 diabetes. Self-reported evidence indicates a low-fat diet became customary to the U.S. after the 1980 dietary fat recommendations, followed by a drastic increase in obesity and type 2 diabetes. Coronary Heart Disease remains the leading cause of death. Consumer confusion may be partially influenced by health educator (e.g. Registered Dietitian Nutritionists [RDNs]) mixed messaging.

Purpose of the Study

The purpose of this study is to assess perceptions, nutrition knowledge, and personal dietary patterns regarding fat intake among a random sample of Registered Dietitian Nutritionists (RDNs).

CHAPTER 2. LITERATURE REVIEW

For the past 80 years in the U.S., CHD has contributed to one in every four deaths (CDC, 2013). At least half of the individuals in the U.S. have one or more of the three major risk factors for CHD, which include high blood pressure, high blood levels of low-density lipoprotein (LDL), and tobacco use (CDC, 2013). Other CHD risk factors include type 2 diabetes, obesity, poor diet, physical inactivity and excessive alcohol use (CDC, 2013). Diet is one of the lifestyle factors related to cardiovascular health, driving the parameters addressing fats as part of the USDA DGA **(**USDA, 2010; HHS, 2010). The DGA have been published every five years since 1980. One of the major suggestions in the 1980 guidelines was to "avoid too much fat, saturated fat, and cholesterol" (USDA, 1980; HHS, 1980). These recommendations were made with the goal to decrease CHD. When the guidelines were released in the 1980's, confusion ensued because education was not provided to the public regarding food substitutions for the recommended reduction in fat calories. The guidelines grouped fats as a whole, stating they should all be decreased, but did not focus on specific fat sources, nor break down fat into the various types (USDA, 1980; HHS 1980).

Low-fat diets became "customary" in the U.S. as obesity rates increased and a national focus on weight loss emerged (La Berge, 2008). The desired outcome of low-fat diets was to aid in weight reduction and reduce CHD risk. In the 1940s, when CHD first became the leading cause of death in the U.S., scientists began to search for causes. Coronary heart disease is a general term used to describe many different problems related to the cardiovascular system such as plaque buildup in the artery walls or atherosclerosis. In addition, plaque buildup leads to narrowing of arteries, which slows blood flow and

increases risk of heart attack or stroke (American Heart Association [AHA], 2015). The "diet-heart hypothesis" was formed stating that diets high in SFAs and cholesterol were a major cause of CHD (La Berge, 2008). Saturated fatty acids (SFAs) are molecules with no double bonds between carbon molecules leading to hydrogen saturation. Saturated fatty acids are found naturally in many foods, primarily animal-based (e.g. fatty beef, lamb, pork, butter, cheese) and solid at room temperature (AHA, 2015). Cholesterol is a substance produced or consumed by humans and is only found in animal-based food (e.g. meat, poultry and full-fat dairy products). It has been theorized that the liver produces more cholesterol when a diet rich in SFAs and trans fatty acids is consumed (AHA, 2014c). Partially hydrogenated oils are often used to extend shelf life and to give foods a desirable taste and texture (AHA, 2014a). Added trans fatty acids are typically found in processed foods as "partially hydrogenated oils". Significant evidence supporting this "diet-heart hypothesis" is lacking (La Berge, 2008).

Evolution of Dietary Fat Intake

The U.S. and United Kingdom's nutrition committees released their dietary guidelines around 1980. Reduction of (overall) fat intake was an area of focus with a goal to reduce CHD. When these guidelines were released, the evidence to support the fat-reduction recommendations was inconclusive. A study of interest was the Seven Countries Study by Keys and Aravanis, which indicated CHD mortality was related to high serum cholesterol values; influenced by diets rich in SFAs (Keys & Aravanis, 1980). This epidemiological study was limited by lack of longitudinal research. In a review of six random controlled trials (RCTs) pertaining to the dietary fat guidelines and CHD risk, researchers examined the relevance of dietary fat and serum cholesterol to mortality.

Overall, there were 2,467 deaths among the participants in the six RCTs. The study included five RCTs with secondary prevention focus among participants with CHD and one including primary prevention of healthy subjects. The control trials examined replacement of SFAs with vegetable oil as part of an approximately 20% fat diet. Individuals that followed a 10% or less SFA diet had a higher rate of death than individuals in the control group. Out of 1,227 participants in the intervention groups and 1,240 participants in the control groups, there were 370 deaths total. There was a 30.2% all-cause mortality rate in the intervention groups and a 29.8% mortality rate in the control groups. Additionally, 207 deaths from CHD were recorded in the intervention groups and 216 deaths were documented in the control groups. In other words, there were very limited differences related to dietary fat consumption when comparing CHD mortality groups and dietary inventions. Furthermore, mean serum cholesterol levels were reduced in the intervention (-12.6% ±6.7%) and control groups (-6.5% ±5.1%). The reductions in mean serum cholesterol levels were significantly higher in the intervention group compared to the control group; however this did not result in significant differences in CHD or all-cause mortality (relative risk [RR] of 0.989, 95% confidence interval [CI] 0.784 to 1.247) (Harcombe et al., 2015).

Regarding the 1980 USDA DGA, Harcombe states,

> "The bottom line is that there was not evidence for those guidelines to be introduced. One of the most important things that should have underpinned the guidelines is sound nutritional knowledge, and that was distinctly lacking" (Harcombe et al., 2015).

Furthermore, Judith Wylie-Rosett, a professor of epidemiology and population health at Albert Einstein College of Medicine and a spokesperson for AHA states,

> "roughly a third of the cholesterol from food becomes part of the circulating cholesterol that can potentially build up in the heart vessels – not a major driver" (Park, 2015).

The AHA has gradually begun revising the guidelines moving away from suggesting lowered fat diets. The focus has switched to diet as a whole and the type of fat that is providing calories (Park, 2015). The AHA recommends increased awareness of how much SFA is consumed, but not on restricting the total fat intake (Park, 2015). The suggestion of consuming lean meats and fish remains; the emphasis on total fat is no longer dominant (Park, 2015).

Similar to USDA, AHA and CDC recommend total fat consumption to provide 20 to 35% of total calorie intake, avoidance of trans fatty acid intake to less than 1% of total daily calories, and cholesterol intake less than 300 mg per day. However, AHA recommends limiting SFAs to less than 7% of total calories whereas the CDC and USDA recommend limiting SFAs to less than 10% of daily caloric intake (AHA, 2015c; CDC, 2012; U.S. Department of Agriculture and U.S. Department of Health and Human Services, 2015). According to AHA, to promote health benefits, the majority of fat intake should be primarily composed of monounsaturated fatty acids (MUFAs) and polyunsaturated fatty acids (PUFAs). For example, avocados, peanut butter, and fatty fish (e.g. salmon, mackerel, and herring) are recommended to be included within the diet (AHA, 2014b & CDC, 2012). Further, the U.S. Food and Drug Administration (FDA) has

mandated a ban on adding imitation or manufactured trans fatty acid to foods effective 2018 (FDA, 2015).

In 1960, U.S. individuals consumed approximately 45 % of calories from dietary fat. By 1995, average dietary fat consumption had decreased to about 35 % of caloric intake (USDA Center for Nutrition Policy and Promotion, 1998; Flegal et al., 1998, & Aubert R, 1995). Despite decreased fat intake, CHD is still the leading cause of death and other risk factors for CHD have increased, such as obesity and overweight, type 2 diabetes. Roughly 13 % of adults were obese and less than one % of U.S. adults had type 2 diabetes related to obesity in 1960 (CDC, 2014a). More recently, most individuals in the U.S. consumed less fat within their diets (e.g. approximately 33.0 % of calories) (CDC, 2014b). Also, 35.1 % of adults age 20 years and above are obese and 9.3 % have type 2 diabetes (Flegal, Carrol, Ogden, and Curtin, 2010; CDC, 2014b). This leads to the question: Why hasn't reducing dietary fat intake contributed to reducing these primary risk factors for CHD as predicted?

Fats often are classified into two different categories: "good fats" and "bad fats". The good fat category includes MUFAs, PUFAs, and omega-3 (n-3) fatty acids, which have potential cardiovascular benefits. The "bad fats" are considered to be trans fatty acids and SFAs, which may evoke disease (CDC, 2014b). However, Jakobsen et al. (2010) and Hu (2010) found that most people restrict fats as a whole regardless of classification as "good" or "bad". Additionally, when fat calories are restricted, calories from processed carbohydrates are often the replacement (Hu, 2010). These carbohydrate products are often white bread, sugary drinks or fat-free products that have added sugar and refined carbohydrates (Hu, 2010). Replacing "bad fat" calories with processed

carbohydrates is associated with increased triacylglycerol (TAG) levels (Jakobsen et al., 2009).

In the past, carbohydrate intake in conjunction with CHD risk received insufficient attention. A recent pooled analysis determined substituting carbohydrate for SFAs is associated with a moderately higher risk of CHD (Jakobsen et al., 2009). One limitation of the study is that type of carbohydrate was not considered. Specifically, quality of carbohydrate such as dietary fiber content, extent of processing (whole versus refined grain), and glycemic index (GI) may be important variables (Jakobsen et al., 2009 & Astrup et al., 2011). Glycemic Index is defined as the area under the blood glucose curve after consumption of 50 grams of digestible carbohydrate from a test food. This test food is divided by the blood glucose curve after eating a similar amount of a control food, generally from glucose or white bread. A high GI food will have a higher peak than a lower GI food (Brand-Miller et al., 2009). However, Jakobsen et al. (2010) completed a similar prospective cohort study examining the risk of myocardial infarction (MI) in association with GI variant carbohydrate intake compared to SFA consumption. The study included 160,725 women and men ages 50 to 64 years old. All participants were free of MI at baseline of the study. Two models were used to assess if SFA intake should be replaced with unsaturated fatty acids or carbohydrates to prevent CHD risk. The first model included intake of carbohydrates, proteins, MUFAs, and PUFAs expressed as percentages of total caloric intake, and alcohol consumption. The second model examined the variables in model one and body mass index (BMI), smoking status, leisure-time physical activity, and history of hypertension. Three tertiles of dietary GI values were calculated based on dietary GI among cases. The first tertile assessed

substitution of low-GI values for SFAs, the second observed medium-GI values for SFAs, and the third examined high-GI values for SFAs. The results indicate there were 1,943 cases of MI (537 male and 1406 female) during a median 12-year follow-up. A nonsignificant inverse association existed between substitution of carbohydrate with low GI-values for SFAs and risk of MI. However, a significant positive correlation existed between substitution of carbohydrate with high-GI values for SFAs and MI risk. Lastly, no association between medium-GI values in place of SFA existed. In conclusion, type of carbohydrate replacement for SFA could impact cardiovascular risk. A higher fiber and lower GI carbohydrate substitution in place on SFA intake decreased MI risk (Jakobsen et al., 2010).

Sweetened products such as calorically dense beverages, grain-based desserts, syrups and candy are the major sources of added sugar (Pomeranz, 2012). Recent analyses suggest adults aged 18 to 54 consumed 33% of their daily sugar caloric intake from beverages (USDA and HHS, 2010). The DGA, 2010-2015 recommend limiting added sugar intake to approximately 5 to 15% of caloric intake per day (Ervin, Kit, Carroll, Ogden, 2012). Additionally, the DGA 2015-2020 recommend consuming less than 10% of calories per day from added sugars (USDA and HHS, 2015). Recent data suggest that both children and adolescents consume approximately 16% of their calories from added sugars with roughly 40% of the added sugar calories coming from beverages (CDC, 2013). Adults consumed approximately 13% of total caloric intake from added sugars between 2005 and 2010 (CDC, 2013). Ambrosini et al. (2013) tested the hypothesis that cardiometabolic risk factors increased related to increased sugar-sweetened beverage (SSB) intake. The SSBs of interest were carbonated soft drinks, fruit

drink concentrate drinks and fruit juice drinks (with the exception of 100% fruit juice). The study included 1,433 adolescents aged 14 to 17 years old. The variables measured or estimated in the study included SSB through a food-frequency questionnaire, BMI, waist circumference, blood pressure, fasting serum lipids, glucose, insulin, and overall cardiometabolic risk. The results indicate there was an average SSB intake of 335 grams per day or 1.3 servings per day. The female adolescent participants who consumed greater than 1.3 servings per day had an increased prevalence of both overweight/obesity and overall cardiometabolic risk. Also, girls and boys who consumed greater than 1.3 servings of SSB had lower HDL cholesterol independent of BMI status. To summarize, increased SSB intake can have a positive correlation with increased cardiometabolic risk in adolescents, independent of weight status (Ambrosini et al., 2013). Many dietary choices continue to be made with little regard to the dietary guidelines, leading to increased CHD risk.

The recently proposed (now newly released) 2015-2020 DGA suggest that restriction of SFAs does not need to be as limited as previously suggested by the committee (Dietary Guidelines Advisory Committee, 2015). The nutrition advisory committee stated,

> "Sodium, saturated fat, and added sugars are not intended to be reduced in isolation, but as a part of a healthy dietary pattern that is balanced, as appropriate, in calories. Rather than focusing purely on reduction, emphasis should also be placed on replacement and shifts in food intake and eating patterns. Sources of saturated fat should be replaced with unsaturated fat, particularly polyunsaturated fatty acids."

The committee also indicated reducing sodium and SFA intake is attainable by consuming a healthy dietary pattern. This dietary pattern is suggested with proposed benefits of reduced risk of CHD, overweight, and obesity along with positive health benefits beyond these categories for the U.S. (Dietary Guidelines Advisory Committee, 2015).

Different Forms of Fat Intake

Even though the national DGA committee recommends reduced SFAs, there is a research gap on what these calories should be replaced with to obtain optimal nutrient balance. It is unclear if SFAs should be replaced with PUFAS and MUFAS or carbohydrate intake.

Omega-3 (n-3) and omega-6 (n-6) fatty acids, both essential fatty acids, and SFA replacement has become a popular topic of discussion regarding fat consumption. Linoleic acid (LA) is an essential polyunsaturated n-6 fatty acid whereas alpha-linolenic acid (ALA) is an essential polyunsaturated n-3 fatty acid. Blasbalg et al. (2011) examined the increasing concern about the changes in consumption of essential fatty acids throughout the twentieth century. The food availability data for foods from 1909 to 1999 were obtained from Economic Research Service of the USDA. Three-hundred seventy-three different food commodities contributing to fatty acid consumption were examined. Economic disappearance data for each year from 1909 to 1999 was used to complete this. The nutrient compositions for 1909 were demonstrated by using current foods (1909-Current) and foods produced by traditional early twentieth century practices (1909-Traditional). The key finding of this study was that estimated per capita soybean oil consumption increased greater than 1000-fold from 1909 to 1999. Soybean oil is the

second highest planted crop in the U.S. and it is most often used for deep-frying, salad dressings, and margarine (USDA, 2012). The availability of LA (n-6) increased from 2.79% to 7.21% of energy, and ALA (n-3) increased from 0.39% to 0.72% of energy using the 1909-Current model. According to the 1909-Traditional model, LA was 2.23% of energy, and ALA was 0.35% of energy. The ratio of n-6 LA to n-3 ALA increased from 1909 to 1999. However the 1909-Traditional to 1909-Current data showed significant declines in dietary availability of n-6 arachidonic acid, n-3 eicosapentaenoic acid (EPA) and n-3 docosahexaenoic acid (DHA). The n-6 arachidonic acid is thought to be a pro-inflammatory n-6 PUFA. Consumption of EPA and DHA both forms of n-3 fatty acids, has been associated with reduced CVD risk. The predicted net effects of these changes indicate declines in tissue n-3 highly unsaturated fatty acid status (Blasbalg et al., 2011).

Supplementation of n-3 has been shown to enhance coronary health benefits. Studies have shown a 45 % reduction in sudden death from CHD in those who took EPA or DHA supplements (Academy of Nutrition and Dietetics [AND], 2015b). However, there were little to no benefits in n-3 supplementation in some individuals, especially those who do not actually have CHD (AND, 2015b).

Similarly, Mozzafarian, Micha & Wallace (2010) conducted a meta-analysis of 54 published papers that included participants who increased total or n-6 polyunsaturated fatty acids (n-6 PUFA) consumption for at least one year without other major interventions. Similar to the previous studies mentioned, the purpose of this study was to determine the connection between SFAs and LDL levels in conjunction with CHD and what SFAs should be replaced with in the diet. There were 1,042 CHD events out of the

13,614 participants. Average PUFA consumption was 14.9% of calories in the intervention group compared to 5.0% of calories in the control group. The overall risk reduction was 19.0% and the CHD risk reduction was 10.0% for every 5.0% PUFAs calorie increase (RR = 0.90, 95% CI 0.83–0.97). To summarize, replacing SFAs with PUFAs consumption decreased CHD events. However, not all PUFAs have the same makeup and it is likely that sources varied. Some PUFAs have anti-inflammatory properties similar to MUFAs while others are pro-inflammatory (Diekman, 2015). According to Calder, EPA and DHA are examples of PUFAs aiding in anti-inflammatory responses (Calder, 2013).

Jakobsen et al. (2009) reviewed 11 North American and European cohort studies, which included a follow-up study with participants who experienced 150 or more coronary events, data of usual dietary intake, and a validation study of the diet-assessment method used. A food frequency questionnaire was used to determine dietary intake at baseline. Then, total energy intake was estimated and separated into fat, carbohydrate and protein intake—the three macro-nutrients. Fat was further broken down into MUFAs, PUFAS and SFAs. The objective of the study was to assess if replacing SFA intake with unsaturated fatty acids and carbohydrates would reduce CHD risk. Additionally, the outcome measures consisted of fatal CHD and MI events. Hazard ratios with a 95% confidence interval were established for each study to examine the incidence between a coronary event and mortality from CHD. Two separate model groups were formed to assess SFA intake replacements and CHD risk. The first model included MUFAs, PUFAs, trans fatty acids, carbohydrates and protein percentages out of the total energy intake. Age was taken into consideration at entry. The second model contained the

variables from model one plus CHD risk factors measured at baseline: smoking, physical activity, highest educational level, alcohol consumption, history of hypertension and energy-adjusted quintiles of fiber intake and cholesterol intake. Two age groups (<60 yr. and >60 yr.) were formed to increase reliability of results. The corresponding results identified 5,249 coronary events along with 2,155 coronary deaths among the 344,696 persons during the 4 - 10 year follow up(s). A hazard ratio was used to express the chance of events, which was CHD risk, of occurring in the treatment versus the control. Also, a 95% confidence level was used. This study demonstrates the true values of the overall population lies between confidence interval ratios. There was a positive direct association between substituting MUFAs for SFAs and coronary events but not coronary related deaths (Jakobsen et al., 2009). A significant inverse relationship (hazard ratio [HR] 0.87; 95% CI:1.01, 1.04) exists between substituting PUFAs for SFAs and coronary event risk and overall coronary deaths. A direct negative association between carbohydrate substitution and risk of coronary events was present however, no significant risk of coronary deaths was identified (HR: 1.07; 95% CI: 1.01, 1.14). Women aged less than 60 years old had an inverse association between PUFA substitution and risk of coronary events. These results indicate SFA intake should be replaced with PUFAs rather than MUFAs or carbohydrate to reduce CHD risk. Quality of carbohydrate was not examined in this study, which may alter results. For example, fiber content, degree of processing and glycemic index may play a role (Jakobsen et al., 2009). This study is distinguished by its large sample size and long duration with detailed dietary and lifestyle factors (Hu, 2010).

In addition, van Dijk et al. (2012) examined the metabolic risk variance of participants consuming varying fat types. This crossover study included male participants who consumed a high-fat shake, three times a day including either SFAs, MUFAs, or n-3 PUFAs. The subjects were phenotyped with MRI for adipose tissue distribution. The researchers assessed change in plasma cytokine, glucose, insulin, triglyceride, and free fatty acid concentration post-high fat challenges. Before, two, and four hours after shake consumption blood was drawn to measure metabolic and inflammation-related genes. The expression of inflammation genes MCP1 and IL1-beta in peripheral blood mononuclear cells (PBMCs) was higher in the MUFA and n-3 PUFA challenge, compared to the SFA challenge. The high-fat challenge resulted in different PBMC gene expression and metabolic responses to obese and obese diabetic participants compared to the responses of the lean participants. The MUFA challenge contained the largest TAG spike in TAG response, mainly in the obese and obese diabetic subjects. Specifically, high-fat challenges affect the PBMC gene expression response and metabolic response related to the metabolic risk phenotype and fat type (van Dijk et al., 2012).

Dietary Fat Intake Related to Coronary Heart Disease (CHD)

Specific food source of SFAs in regards to the effects on the body and the link between replacing SFAs with carbohydrates in relation to the rising obesity rates are important considerations regarding SFA consumption and CHD risk (Astrup et al., 2011 & Jakobson et al., 2009). Among countries following the Western diet, replacing 1% of energy intake from SFAs with PUFAs has been shown to reduce incidence of CHD by 2 to 3% (Astrup et al., 2011). The Western diet contains excessive SFA and trans fatty acid consumption along with little n-3 PUFA and n-6 PUFAs consumption. The assumption

that consumption of SFAs raise total and LDL cholesterol is proposed to be too simplistic of a paradigm (Astrup et al., 2011). When replacing SFAs with refined carbohydrates, there can be a decrease in HDL cholesterol and LDL particle size and increases in TAG and plasma glucose (Jakobsen et al., 2009). Decreased HDL and LDL particle size and increase in TAG and glucose increase risk for CHD (AHA, 2015d).

Furthermore, the metabolic profile is likely adversely affected by increased refined carbohydrate intake, e.g., inflammatory markers and thrombotic factors (Astrup et al., 2011). Biomarker data, including total cholesterol suggest that MUFA replacement would be beneficial although the relation to clinical endpoints is currently limited (Astrup et al., 2011). Astrup theorizes there is strong evidence that high intake of processed meat products, a major source of SFA, increases risk of CHD. He asserts, there is no consistent data supporting higher intake of dairy products in relation to an increased CHD risk in epidemiologic studies. But, data does support higher dairy intake relationship with increased risk for type 2 diabetes (Astrup et al., 2011). The total matrix of food is important when considering CHD risk. For example, SFAs in natural cheese may affect blood lipids and CHD risk yet is rich in other nutrients such as protein and calcium.

Siri-Tarino, Sun, Hu, and Krauss (2010) performed a meta-analysis to estimate the risk of CHD risk and stroke and risk for both CHD and stroke, or total CVD that was associated with dietary intakes of SFA. The random effects model was used to compare 21 studies, assessing relative risk estimates for CHD, stroke and CVD. In a 5 to 23-year follow-up of 347,747 subjects, 11,006 developed CHD or stroke. The results disclosed that increased SFA intake was not significantly associated with increased risk of CHD, stroke or CVD. The relative risk estimates for SFA included 1.07 for CHD, 1.00 for

CVD, and 0.81 for stroke. Controlling for age, sex and study quality did not alter the results. The authors concluded no significant association between increased SFA intakes and increased CHD or CVD risk however, further research is needed (Siri-Tarino, Sun, Hu & Krauss, 2010). A major limitation of the study is that few studies included data evaluating replacing SFA with carbohydrate or PUFAs.

A specific dietary fat receiving consumer and RDN attention is coconut oil. Coconut oil consumption, a plant-based source of saturated fat, decreased when the 1980 DGAs recommended limitation of saturated fats (Melnick, 2014). Coconut oil has begun to make a consumer consumption comeback related to the recent research regarding SFA intake. A few media-reported health benefits of coconut oil include improved cholesterol profile, promotion of weight loss, and protection of cortical neurons in the brain, which reportedly reduce Alzheimer's disease risks (Melnick, 2014). Coconut oil is high in SFA however, it is a plant based fat made up of lauric and myristic acid (Cunningham, 2011). According to one observation lauric acid, decreases the total to HDL cholesterol ratio by increasing HDL levels however this has not been identified in other studies (Cunningham, 2011).

Correspondingly, a recent pooled study containing prospective, observational studies and randomized, controlled trials was conducted among 32 observational studies (Chowdhury et al., 2014). Relative risk of CHD was 1.16 for trans fatty acids, 1.03 for SFA, 1.00 for MUFA, 0.98 for n-6 PUFA, and 0.87 for long-chain n-3 PUFA, when dietary fatty acid intake was compared. The circulating fatty acids were 1.06 for SFA, 1.06 for MUFA, 1.05 for trans fatty acids, 0.94 for n-6 PUFA, and 0.84 for long-chain n-3 PUFA. Heterogeneity was present in the association of individual circulating fatty acids

and CHD risk. In other words, the current recommendations of increased PUFA and low SFA to prevent CHD are not supported by research from the 32 studies (Chowdhury et al., 2014). Additionally, there was not a statistically significant association in prospective studies of CHD that involved intake of n-6 polyunsaturated fatty acids. However, dietary n-3 polyunsaturated fats (supplement dose ranging from 0.3 to 6.0 g/day where dietary oil was the principal form of supplementation) were associated with lower risk of CHD. In contrast, total and individual MUFAs had a null association with CHD risk in studies using dietary intake and circulating fatty acid biomarkers. Finally, there was a null association between SFAs and CHD risk in the studies using dietary intake and circulating biomarker studies (Chowdhury et al., 2014). However, the authors reported limited data available on fatty acids and overestimations by selective reporting results for publication of extreme findings (Chowdhury et al., 2014).

Given the lack of nutritional knowledge backing up dietary fat guidelines, consumer confusion arises (Harcombe et al., 2015). It is unclear as to which guidelines are the most appropriate. Furthermore, individuals are influenced by many different factors when making food choices. The "sectors of influence" that play a role in food choice, including government are numerous (figure 1).

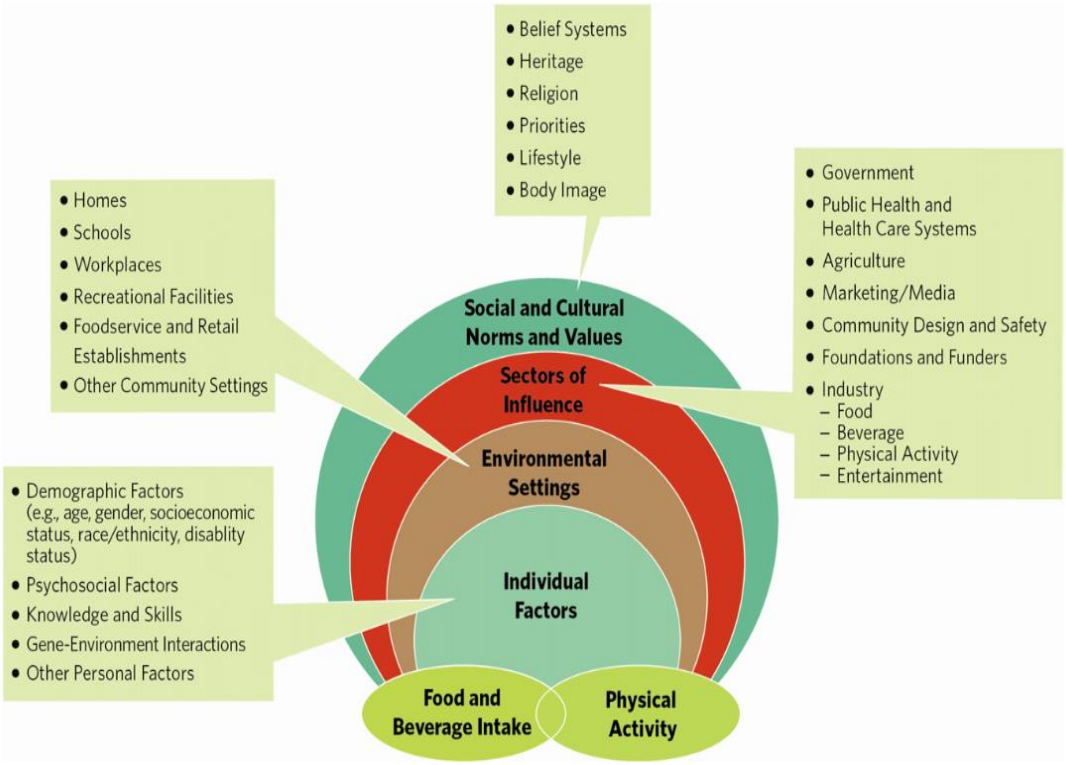

Figure 1. The Social Ecological Model. Reprinted from the Dietary Guidelines for Americans (USDA, 2010)

Based on the Social Ecological Model (figure 1), individuals adjust their dietary choices based on individual factors, environmental settings, sectors of influence and social and cultural norms and values. Individual factors are the most important determinant to food choices based on demographic factors, psychosocial factors, knowledge and skills, gene-environment interactions and other personal factors in domain 1. When not only the consumer, but also the nutrition experts become unsure about their knowledge and skills (to make dietary recommendations and choices), an increase in poor choices may occur; alternatively, the entire food (e.g. fatty foods) may be restricted or avoided. Domain 2 includes environmental settings, which play a role on personal nutrition. Settings such as homes, schools, workplaces, recreational facilities, foodservice and retail establishments, and other community settings can influence dietary

choices. Location of practice is important to a RDN making recommendations that are affected by access, transport, and healthful food options. Domain 3 lists sectors of influence such as government, public health and health care systems, agriculture, marketing/media, community design and safety, foundations and funders, and the industry (food, beverage, physical activity, and entertainment). These are the next factors contributing to food choices. The variety of media and government recommendations may affect RDN confidence when making recommendations to the general and diseased populations. RDNs may become unsure of what to recommend, given recent reports and scientific research. Finally, domain 4 includes social and cultural norms and values such as belief systems, heritage, religion, priorities, lifestyle, and body image, all valuable indicators influencing food selections (USDA, 2010). According to the Social Ecological Model, every RDN would have different priorities and lifestyle factors (e.g. specific diets, family background, personal beliefs) influencing personal dietary practices, which may relate to their practice recommendations.

Summary and Recommendations

The 1980 dietary fat guidelines were released when scientific data to support them was lacking (Harcombe et al., 2015). Dietary fat consumption has greatly changed over the years. Partially due to current and previous DGA suggesting reduced dietary fat intake, Americans have greatly decreased dietary fat intake and replaced these calories with refined grains (Flegal, Carrol, Ogden, Curtin, 2010 & CDC, 2014a). Despite reductions in fat intake, obesity, type 2 diabetes, and CHD prevalence have significantly increased since 1960.

Jakobsen et al. (2009) & Hu (2010) found that people tend to restrict fats as a whole rather than focusing on the different types of fat consumption. When these calories are restricted, there is not a clear concise recommendation on what they should be replaced with. Jakobsen et al. (2009) had a key finding that SFA intake should be replaced with polyunsaturated fatty acid (PUFA) intake rather than monounsaturated fatty acid (MUFA) or carbohydrate (CHO) intake to prevent coronary heart disease (CHD) (Kris-Etherton, 2015). Professional groups specializing in cardiovascular and overall health have different recommendations for dietary fat intake (table 1).

Table 1

Summary of dietary fat recommendations (U.S.), 2015

Summary of dietary fat recommendations (U.S.)					
	Total Fat	PUFA	MUFA	SFA	Trans fatty acid
AHA, 2015	25 – 35% of total calories	Majority of fat calories	Majority of fat calories	< 7 % or 5 – 6 % of calories for those trying to lower LDL cholesterol	< 1 %
National Lipid Association, 2014	Low-fat diet recommended for individuals with high TAG (e.g. triglycerides)	Partially replace refined CHO intake with unsaturated fats to ↓ triglyceride levels and ↑ HDL cholesterol	Partially replace refined CHO intake with unsaturated fats to ↓ triglyceride levels and ↑ HDL cholesterol	Reduce dietary intake due to high SFA diet's association with increased LDL levels	↓ trans fatty acid consumption
Dietary Guidelines Committee, 2015	Emphasis on adequate fat consumption. ↓ fat diets are not related to reduced CVD risk.	Replace SFA with unsaturated fat, especially PUFAs	Limited evidence supporting reduced CVD risk with replacement of SFA with MUFAs	Retain upper limit of 10% of calories	Avoid partially hydrogenated oils
Evidence Analysis Library position paper, 2014	20 – 35 % of total calories	↑ PUFA consumption with a focus on n-3 intake while striving to consume 2 or more servings of fatty fish per week	Moderate intake of MUFA (15% - 20%)	< 7 – 10% of calories	Intake as low as possible

Regardless of mixed recommendations, dietary fat intake tends to be directly linked to CHD. Current nutritional recommendations encourage decreased consumption of SFAs, increased consumption of n-3 PUFAs from fish or plant sources, and less than 2 grams daily of trans fatty acids to promote cardiovascular health (AHA, 2014a). Yet, mixed inconclusive evidence to support these recommendations exists.

CHAPTER 3. METHODS AND PROCEDURES

The purpose of this study was to assess the perceptions regarding fat intake and fat recommendations among a random sample of Registered Dietitian Nutritionists (RDNs).

Research Questions

1) What is the RDN level of confidence for making accurate/current dietary fat recommendations?
2) What are RDNs recommending for total fat, SFA, fat "trends" such as coconut oil, and fish oil supplements?
3) How do RDN dietary practices relate to their practicing recommendations?

Electronic surveys were chosen because of their anticipated increased outreach and response rate among RDNs due to familiarity and accessibility of computer software. Furthermore, electronic surveys are cost effective, easily prepared and they provide readily available statistical data (Schmidt, 1997).

Study Design

To assess individual planned food choices, a cross-sectional survey design was used to gather demographic information, dietary patterns, consumption choices, and nutrition knowledge regarding dietary fat choices among RDNs (Appendix C). The first version of the Fat Facts survey was test-piloted with local RDNs. Qualtrics is web-based survey software that was used for administering the survey. The Qualtrics survey allowed for colors, bolded print, borders, and other formatting (Qualtrics, 2013, Provo, UT). After the pilot test, five questions were modified, one question was deleted and two questions

were added to the finalized survey. One $20 Amazon gift card was given out in August 2015 to one of the first randomly drawn 150 respondents.

Participants and Recruitment

During July 2015 (before the DGA 2015-2020 was released), RDNs were recruited to participate in the survey via email announcements through the Commission of Dietetic Registration (CDR) listserv after obtaining permission from CDR (Appendix D). The sample of RDNs was randomly chosen by the CDR. Once the participant received the URL (Appendix A), they were directed to the informed consent form (Appendix B). Instructions on survey completion were provided. Application and approval to the Institutional Review Board was completed before recruitment (Appendix E).

Study Instruments

A brief electronic survey using Qualtrics including demographic questions, questions regarding food frequency intake, type of dietary fat consumption, and nutrition knowledge was designed (Appendix C). This Fat Facts survey instrument was partially based on the Social Ecological Model to help determine which drivers influence choices in dietary fat consumption (USDA, 2010). A five point Likert-scale ranging from "never" to "always" was used to assess strength of responses. The survey URL was emailed July 2015 and remained available for two weeks.

Data Analysis

Analysis of Variance (ANOVA) statistics for comparison by area of dietetic practice (e.g. SCAN groups, etc.) was completed to detail RDN level of confidence when making accurate/current dietary fat recommendations. Descriptive statistics were utilized

to detail RDN recommendations regarding total and other fats, coconut oil and other "trendy" fats, and fish oil supplements. Comparisons of RDN personal dietary habits with professional practice recommendations were determined using logistic regression analysis. All statistics were performed using SAS Institute Inc. 9.3, 2011 (Cary, NC). The Bonferroni correction for multiple testing was utilized which took the original significance value (alpha), which in this case is 0.05, and divides it by the total number of tests to come up with the new significance cut-off (0.01).

CHAPTER 4. IS IT TIME TO REEVALUATE OUR DIETARY FAT GUIDELINES?[1]

Abstract

Despite Dietary Guidelines for Americans (DGAs) focus on decreased fat intake, coronary heart disease remains the leading cause of death in the United States. Consumer-confusion regarding fat-recommendations in response to these guidelines may be related to health educator (e.g. RDN) mixed-messaging. A random sample of RDNs (n=281), completed an online-survey targeting perceptions, knowledge, and dietary patterns regarding fat. Survey responses provided insights such as: 70% of RDNs strongly-agree olive oil should be regularly-utilized, 99% agree omega-3 fatty acids promote health, and 69% believe it is important to consider fat when choosing foods. Additionally, 40% of RDNs "rarely"/"never" recommend fish-oil supplements and 46% "rarely"/"never" use fat-free/reduced-fat products. Regarding confidence of fat's effect on health, 19% were "neutral"/"unsure" of polyunsaturated fatty-acids. Of the RDNs surveyed, 22% agreed recent changes in DGAs decreased their confidence making fat-recommendations. Results indicate importance of science-based fat-recommendations in relation to RDN recommendations.

Keywords: Registered Dietitian Nutritionists (RDNs), dietary fat intake, nutritional knowledge, dietary patterns, recommendations

[1] This chapter has been submitted as a journal article to the Journal of the Academy of Nutrition and Dietetics.

Introduction

In 1980 when the first United States (U.S.) dietary recommendations were released, avoidance of too much fat, saturated fatty acids (SFAs), and cholesterol was suggested (U.S. Department of Agriculture [USDA] and U.S. Department of Health and Human Services [HHS], 1980). These guidelines indicated consumption of excess SFA and cholesterol would increase serum cholesterol levels in most people. However, this reaction was supposed to vary due to heredity and individual response to cholesterol (USDA; HHS, 1980). These recommendations were proposed because coronary heart disease (CHD) was the leading cause of death in the U.S. at the time (Centers for Disease Control and Prevention [CDC], 2010). However, conclusive nutritional data to justify recommendations was lacking when these guidelines were released (Harcombe et al., 2015; Park, 2015).

After the 1980 Dietary Guidelines for Americans (DGA) were released, fat consumption significantly decreased throughout the U.S. In 1960, U.S. individuals consumed approximately 45 % of calories from fat. However, in 1995 dietary fat consumption was reduced to about 35 % of caloric intake (USDA Center for Nutrition Policy and Promotion, 1998; Flegal et al., 1998, & Aubert et al., 1995). Despite decreased fat intake, CHD was and still is the leading cause of death in the U.S. for both men and women. Other risk factors for CHD have increased (such as obesity and overweight, and type 2 diabetes). Roughly 13 % of adults were obese and less than one % had type 2 diabetes related to obesity in 1960 however, more recently 35.1 % of adults are obese and 9.3 % have type 2 diabetes (Flegal, Carrol, Ogden, and Curtin, 2010; CDC, 2014a). With this in mind, revisiting the current dietary fat recommendations and

evaluating new research regarding dietary fat is essential to assess reliability of current-proposed dietary recommendations.

Given the lack of nutritional knowledge backing up former dietary fat guidelines, consumer confusion arises (Harcombe et al., 2015). It is unclear as to which guidelines are the most appropriate. Furthermore, individuals are influenced by many different factors when making food choices. The "sectors of influence" that plays roles in food choice are numerous (figure 1).

Based on the Social Ecological Model (figure 1), individuals adjust their dietary choices based on individual factors, environmental settings, sectors of influence and social and cultural norms and values. Individual factors are the most important determinant to food choices based on demographic factors, psychosocial factors, knowledge and skills, gene-environment interactions and other personal factors in domain 1. When not only the consumer, but also the nutrition experts become unsure about their knowledge and skills (to make dietary recommendations and choices), an increase in poor choices may occur; alternatively, the entire food (e.g. fat) may be restricted or avoided. The government as an influencing factor relates to the fluctuating dietary fat recommendations from various entities (table 1). Professional groups specializing in cardiovascular and overall health have different recommendations for dietary fat intake (table 1).

Methods and Procedures

The purpose of this study was to assess perceptions regarding fat intake and fat recommendations among a random sample of Registered Dietitian Nutritionists (RDNs). Electronic surveys were chosen because of their anticipated increased outreach and

response rate among RDNs due to familiarity and accessibility of computer software. Furthermore, electronic surveys are cost effective, easily prepared and distribute statistical data (Schmidt, 1997).

Study Population

During July 2015 (before the DGA 2015-2020 were released), RDNs were recruited to participate in the survey via email announcements through the Commission of Dietetic Registration (CDR) listserv after obtaining permission from CDR (Appendix D). The sample of RDNs was randomly chosen by the CDR. After the participant received the URL (Appendix A), they were directed to the informed consent form (Appendix B). Instructions on survey completion were provided. Application and approval to the Institutional Review Board was completed before recruitment (Appendix E).

Study Design

A cross-sectional survey design was utilized for the study. Besides collection of demographic data, the survey also addressed dietary patterns, type of dietary fat consumption, and nutrition knowledge (Appendix C). The Fat Facts survey instrument was partially based on the Social Ecological Model to help determine which drivers influence choices in dietary fat consumption (USDA, 2010). A five point Likert-scale ranging from "never" to "always" was used to assess strength of responses. The survey URL was emailed July 2015 and remained available for two weeks.

Level of Confidence for Making Dietary Fat Recommendations

Measures of perceived confidence in making dietary fat (e.g. trans fat, saturated fat, polyunsaturated fat) recommendations were assessed. Participants were asked to report their confidence in making dietary fat recommendations using a Likert-scale (5=very confident, 4=confident, 3=somewhat confident, 2= unsure, 1=very unsure).

Recommendations Regarding Fat "Trends"

Participants were asked questions regarding recommendations for fat "trends" such as coconut oil and fish oil supplements. Questions included personal use of fish oil and coconut oil and whether RDNs would recommend the oils to the general public. Additionally, perceived benefits of coconut oil were assessed with a "select all that apply" question. Level of agreement that coconut oil should be used regularly in food preparation was determined using a Likert-scale from "strongly agree" to "strongly disagree".

Personal Practices in Relation to Practicing Recommendations

Multiple personal practice questions regarding dietary fat consumption were asked in relation to practicing recommendations for the general public. These questions consisted of how RDNs feel they personally follow the current dietary guidelines for total dietary fat and saturated fat. The possible responses ranged from "strongly agree" to "strongly disagree".

Study Instruments

To assess individual planned food choices, a web-based questionnaire was designed to gather demographic information, dietary patterns, consumption choices, and nutrition knowledge regarding dietary fat choices among RDNs (Appendix C). The first version of the Fat Facts survey was test-piloted with local RDNs. Qualtrics is web-based survey software that was used for administering the survey. The Qualtrics survey allowed for colors, bolded print, borders, and other formatting (Qualtrics, 2013, Provo, UT). After the pilot test, five questions were modified, one question was deleted and two questions were added to the finalized survey. One $20 Amazon gift card was given out in August 2015 to one of the first randomly drawn 150 respondents.

Statistical Analysis

Analysis of Variance (ANOVA) statistics for comparison by area of dietetic practice (e.g. SCAN groups, etc.) was completed to detail RDN level of confidence when making dietary fat recommendations. Descriptive statistics were utilized to detail RDN recommendations regarding total and other fats, coconut oil and other "trendy" fats, and fish oil supplements. Comparisons of RDN personal dietary habits with professional practicing recommendations were determined using logistic regression analysis. All statistics were performed using SAS Institute Inc. 9.3, 2011 (Cary, NC). The Bonferroni correction for multiple testing was utilized, which took the original significance (0.05) level (alpha), and divides it by the total number of tests to come up with the new significance cut-off (0.01).

Results

Characteristics of Participants

Two thousand and five hundred randomly selected RDNs enlisted in the CDR listserv were initially sent the Fat Facts Survey. Of those emails sent, 29 emails bounced with the final sample including 2,471 potential candidates. Two hundred and eighty one completed surveys were returned. With the 281 surveys returned out of 2,471, the response rate was 11%. Demographic information for the 281 participants shows that majority of the participants were female between the age of 25 and 60 years old (table 2).

Table 2

Sex, age, and primary area of practice of responding RDNs

	%	n
Sex (n= 280)		
Female	96.8	271
Male	3.2	9
I do not wish to disclose	0	0
Age (n= 281)		
Under 18	0	0
18 – 24	2.8	8
25 – 39	48.8	137
40 – 60	36.3	102
61 or older	12.1	34
Primary area of Practice (n= 281)		
Clinical nutrition-acute care/inpatient	21.7	61
Other	18.9	53
Clinical nutrition ambulatory care	16.0	45
Community	10.0	28
Education and research	10.0	28
Consultation and business	9.6	27
Clinical nutrition-long-term care	9.3	26
Food and nutrition management	4.6	13
Highest level of education (any major) (n=280)		
Master's Degree	47.5	133
Bachelor's Degree	46.1	129
Doctorate Degree	6.4	18
Years of Practice as a RDN (n= 281)		
Less than 5 years	20.6	58
5 – 10 years	22.4	63
11 – 15 years	14.9	42
16 – 20 years	14.2	40
21 – 25 years	5.7	16
26 – 30 years	7.5	21
More than 30 years	14.6	41

Dietary Patterns

The respondents were asked to rate their level of agreement, using a Likert-type scale, that olive oil, canola oil, vegetable oil, vegetable oil spray, butter, margarine, coconut oil or other fats (free text) should be regularly utilized in food preparation. Data

was quantified by converting "strongly agree" to equal 5, "agree" to equal 4, "neither agree nor disagree" to equal 3, "disagree" to equal 2 and "strongly disagree" to equal 1. This data was then summed and divided by the number of respondents per dietary fat category. Overall, out of the seven dietary fats listed, olive oil is rated most highly with an average weighted score of 4.62 (table 3). Additionally, margarine is rated least acceptable to be used in food preparation with a weighted mean (WM) of 2.09.

Table 3

Level of agreement that select fats should be used regularly in food preparation

	Strongly agree (5)	Agree (4)	Neither agree nor disagree (3)	Disagree (2)	Strongly disagree (1)	
	n	n	n	n	n	WM
Olive oil (n=281)	179	97	5	0	0	4.62
Canola oil (n=278)	92	122	39	16	9	3.98
Vegetable oil (soybean, corn, etc. (n=276)	20	78	91	63	24	3.03
Vegetable oil spray (e.g. PAM) (n=276)	30	109	78	31	19	3.26
Butter (n=280)	24	103	75	77	1	3.26
Margarine (n=278)	1	26	54	113	84	2.09
Coconut oil (n=279)	25	74	82	75	23	3.01
Other fat (n=207)	17	25	139	13	13	3.10

Based on the collective results, olive oil was highly recognized and recommended by RDNs with 98% of respondents rating this fat between "agree" and "strongly agree" that it should be regularly utilized in food preparation. However, 77% of RDN respondents "agree" and "strongly agree" with the use of canola oil. A few of the "other

fats" identified by participants included avocado oil, ghee, peanut oil and lard. Only 10% of respondents specified they "agree" or "strongly" agree that margarine should be regularly utilized in food preparation. Likewise, 70% of RDNs selected "disagree" and "strongly disagree" that margarine should be regularly utilized when prepping foods.

Results of the RDN participants when asked questions regarding their level of confidence about considering their own intake of total dietary fat and saturated dietary fat (table 4). These questions were based on the 2010 USDA dietary guidelines.

Table 4

Personal confidence regarding USDA Dietary Guidelines for fat and SFA intake

	%	n
Dietary fat guidelines (20 – 35% of calories from fat) (n=281)		
Strongly agree	20.28	57
Agree	51.25	144
Neither agree nor disagree	13.88	39
Disagree	12.81	36
Strongly disagree	1.78	5
Do you feel confident you: (n=281)		
Eat less than recommended amount of dietary fat	12.46	35
Eat "just the right" amount of dietary fat	65.84	185
Eat more than recommended amount of dietary fat	21.71	61
Saturated fat guidelines (less than 10% of calories from saturated fat) (n=280)		
Strongly agree	20.71	58
Agree	43.93	123
Neither agree nor disagree	15.36	43
Disagree	17.14	48
Strongly disagree	2.86	8
Do you feel confident you: (n=280)		
Eat less than recommended amount of saturated fat	26.79	75
Eat "just the right" amount of saturated fat	46.43	130
Eat more than recommended amount of saturated fat	26.79	75

Of 281 responses regarding confidence considering personal fish oil supplement use, 37% indicated use whereas 63 % responded they do not use the supplement. Other responses include saturated and amount of fat consumed (table 4).

Approximately, 51 % of RDN responders “agree” that they follow the 2010 USDA Dietary Guidelines for fat and 66 % feel they eat “just the right” amount of dietary fat (table 4). Additionally, 44 % of the RDNs surveyed “agree” that they follow the 2010 USDA Dietary Guidelines for saturated fat (less than 10% of calories from saturated fat) and 46 % feel they eat “just the right” amount of saturated fat daily.

Consumption Choices

There are many different factors that play a role in influencing personal food choices was supported in this survey (table 5). Based on the Social Ecological Belief Model (USDA, 2010) a variety of factors drive food choices such as taste, social/cultural, health, nutrition, convenience and cost.

Table 5

Level of importance of factors when choosing the type of fat consumed

	Very important (5)	Important (4)	Neither important nor unimportant (3)	Unimportant (2)	Not important at all (1)	
	n	n	n	n	n	WM
Nutrition (n=279)	180	92	7	0	0	4.64
Health (n=281)	181	95	5	0	0	4.62
Taste (n=280)	96	163	15	5	1	4.24
Convenience (n=278)	23	144	80	27	4	3.56
Cost (n=280)	19	144	73	39	5	3.48
Other (n=163)	15	14	106	0	28	2.93
Social, Cultural (n=278)	19	60	111	50	38	2.90

It appears that health and nutrition are "very important" factors to the responding RDNs as 98 % found health and 97 % identified nutrition as very important or important when it comes to choice of fat. According to the weighted mean (WM) values, nutrition (WM=4.64) and health (WM=4.62) are the most important to RDNs choosing which type fat to consume. Taste (WM=4.24) also appears to an important factor influencing RDN type of fat consumption. In contrast, social and cultural factors (WM=2.90) do not appear to be as important to the RDN sample.

Importance of dietary fat per serving when making food choices was assessed using a five-point Likert-scale. RDNs responded to the Likert-scale ranging from very important to not important at all. About 70% of the responders indicated that amount of dietary fat per serving is very important or important to them. Further inquiries were posed regarding use of fat-reduced foods (table 6).

Table 6

RDN weekly low-fat products self-purchasing prevalence

	Cumulative Frequency (CF)	%	n
Use of processed low-fat products (n=280)			
Always (>5 days per week)	6.79	6.79	19
Most of the time (3-4 days per week)	30.00	23.21	65
Sometimes (2 days per week)	53.93	23.93	67
Rarely (1 day per week)	83.22	29.29	82
Never	100.00	16.78	47
Use of fat-free or reduced fat salad dressing (n=277)			
Always (>5 days per week)	4.69	4.69	13
Most of the time (3-4 days per week)	18.41	13.72	38
Sometimes (2 days per week)	30.32	11.91	33
Rarely (1 day per week)	54.15	23.83	66
Never	100.00	45.85	127
Use of fat-free or reduced fat dairy substitutes, such as creamers (n=277)			
Always (>5 days per week)	6.14	6.14	17
Most of the time (3-4 days per week)	13.00	6.86	19
Sometimes (2 days per week)	21.30	8.30	23
Rarely (1 day per week)	34.66	13.36	37
Never	100.00	65.34	184
Use of fat-free or reduced fat dairy products (n=281)			
Never	14.23	14.23	40
Rarely (1 day per week)	24.28	9.96	28
Sometimes (2 days per week)	40.65	16.37	46
Most of the time (3-4 days per week)	69.12	28.47	80
Always (>5 days per week)	100.00	30.88	87

There appears to be a similarity in response rate between the categories ranging from “always” to “never” using low-fat products. Frequency in purchasing processed low-fat items most of the time (23.21%), sometimes (23.93%), and rarely (29.29%) were similar (table 6). According to the cumulative frequency (CF) statistics, 53.93% of the sample was consuming processed low-fat products two or more times each week. Additionally, 21.30% of respondents use fat-free or reduced fat dairy products two or

more times each week. However, 66.42% indicated they never use fat-free or reduced fat dairy substitutes, such as creamers.

Nutrition Knowledge

RDNs have varying experience and fields of practice, which may play a role in their dietary fat recommendations. Nearly 99% of the 280 RDN respondents agree that n-3 fatty acids have potential health benefits. Additionally 93.21% agree that MUFAS and 90.00% that essential fatty acids have potential health benefits. Furthermore, 77.14% indicated PUFAS, 60.00% n-6 fatty acids, and 18.93% that SFAs have potential health benefits. Only 1.07% agreed that trans fatty acids have potential health benefits. When RDNs (n=280) were asked which fats should be avoided or limited in the general diet, 99.29% and 76.79% of RDNs agree that trans fatty acids and SFAs, respectively, should be avoided in a general healthful diet. In contrast, few responders agreed that n-3 fatty acids (1.43%), essential fatty acids (0.36%), PUFAs (12.14%), and MUFAs should be avoided or limited in a general diet.

RDNs have varying beliefs as to which foods are rich in n-3 fatty acids (table 7). There appear to be discrepancies between RDN's nutritional knowledge regarding foods rich in n-3 fatty acids. Only 31.32% of respondents stated that lake trout was rich in n-3 fatty acids even though lake trout is the highest n-3 containing fish listed. Similar response rates of 72.60% agreed tuna and 72.24% stated that mackerel are rich in n-3 fatty acids. However, 99.10% of RDNs agreed salmon is rich in n-3. Lastly, 9.25% of respondents stated tilapia and 8.90% of respondents agreed that shrimp was rich in n-3 fatty acids. Some of the "other" responses include herring, sardines and walnuts.

Table 7

RDN nutritional knowledge regarding omega-3 (n-3) rich foods

	% of respondents	n-3 content*
Which foods are rich in n-3 fatty acids (n=281)		
Salmon	99.10	1.8
Tilapia	9.25	trace
Shrimp	8.90	0.65
Tuna	72.60	1.5
Lake trout	31.32	4.6
Mackerel	72.24	2.6
Other	22.42	

The recommendation of n-3 fatty acid is at least 2 servings (3.5 ounces or 198.45 grams) per week (AHA, 2015a).

*grams of n-3 fatty acid per 100 grams of edible fish (DeWitt, 2011)

The newest proposed (now newly released) 2015-2020 Dietary Guidelines for fat appear to contribute to perceived confidence among some RDNs for making fat recommendations. When asked about the impact of the proposed 2015 Dietary Guidelines from the DGA Advisory Committee, 54 out of 279 (19.35%) respondents agreed their confidence level was decreased for making dietary fat recommendations. However, 51 out of 279 (18.29%) of RDNs disagreed that the proposed guidelines decreased their confidence level while making fat recommendations. Additionally, 145 out of 279 (51.97%) neither agreed nor disagreed that their confidence level has been affected.

The sample of RDNs was provided the following passage:

> "Dietary fat has many important health functions, and dietary fat intake is important for maintaining healthy cells, skin and eyes, and cognitive development; in addition, it contributes to meal satiety. However, studies have found that excessive fat intake is related to weight gain and heart disease; they

have also found increased intake of solid animal and trans fatty acids contribute to increased levels of serum LDL cholesterol. By replacing trans fatty acids and SFAs with monounsaturated and other healthier fats, we can contribute to overall health while maintaining a satisfying diet."

After reading this paragraph, RDNs were asked to identify any improvements that should be made to their personal diet regarding dietary fat intake. Out of 279 responders, 16.85% stated they would decrease overall dietary fat, 48.03% would decrease trans fatty acid intake, and 44.44% would decrease saturated fat. As far as making dietary fat intake increases, 19.71% stated they would increase PUFAs and 41.94% would increase MUFAs. However, 1.08% stated they would eat plenty of fat-all kinds are ok, 33.69% said they would not make any changes, and 7.89% would make other changes. Lastly, 39.07% said they would eat fat in moderation.

RDN Practice and Recommendation

A significant overall mean difference existed among RDN areas of practice when asked about personal level of confidence in explaining and nutritional knowledge (p=.01) of the following fats: n-3 fatty acids, n-6 fatty acids, and essential fatty acids. Level of confidence was rated on a five point Likert-scale (5=very confident, 1=very unsure). There was not a significant indicator regarding personal level of confidence in explaining fat's effects on health among the different areas of RDN practice. Duncan's multiple comparisons were done to determine specific mean differences.

Table 8

Duncan's multiple comparison of dietetic area of practice and confidence explaining different forms of fat

Duncan Grouping*			**Mean**	**n**	**Practice**
	A		4.44	28	Education & research
	A				
B	A		4.42	27	Consultation & business
B	A				
B	A	C	4.27	45	Clinical nutrition - ambulatory care
B	A	C			
B	A	C	4.22	53	Other
B		C			
B	D	C	4.13	60	Clinical nutrition - acute care/inpatient
	D	C			
	D	C	4.08	26	Clinical nutrition - long-term care
	D	C			
	D	C	4.04	28	Community
	D				
	D		3.91	13	Food & Nutrition Mgmt

*Means with the same letter are not significantly different

The mean (M) response for those practicing in Education and Research (M=4.44) was found to be statistically different than those practicing in Clinical Nutrition- Acute Care/Inpatient (M=4.13), Clinical Nutrition-long-term care (M=4.08), Community (M=4.04), and Food & Nutrition Management (M=3.91).

Additionally, a significant mean difference existed between areas of practice when asked to indicate level of confidence in choosing foods that contain fats that are associated with health benefits on a Likert-scale ranging from very confident to very

unsure. RDNs practicing in Consultation & Business (M=4.67) were significantly more confident than RDNs in Food and Nutrition Management (M=4.23). Even though there are significant mean differences between areas of practice, most RDNs reported high levels of confidence (mean of 4 or higher).

Based on logistic regression analysis, how often RDNs personally use a fish oil supplement was a significant predictor of fish oil recommendations ($p<0.0001$). Responses included "never", "rarely", "sometimes", "most of the time", and "always". The respondent's odds of personally using a fish oil supplement increased 3 times for every unit ("never" to "rarely" is 1-unit) increase in their recommendation of fish oil. For example, a respondent that rarely recommends fish oil was 3 times more likely to take a fish oil supplement than a respondent who never recommends a fish oil supplement. Another example, a respondent that sometimes recommends a fish oil supplement was 3 times more likely to take a fish oil supplement than a respondent who rarely recommends (a 1-unit increase), and 6 times more likely than a respondent who never recommends the supplement (a 2-unit increase).

A second dependent variable was used to evaluate RDN recommendation of increased MUFA in relation to significant predictors of how often RDNs recommend fish oil supplements ($p=0.0150$) and how often RDNs use fat-free or reduced-fat dairy ($p=0.0073$). Since the models treat the dependent variables as categorical, comparisons are made against a reference level. How often RDNs recommend fish oil supplements and how often RDNs use fat-free or reduced-fat dairy had five response levels, ranging from 1 (never) to 5 (always). The reference level used was 5 (always). There was a significant difference ($p=0.0055$) between RDNs who "always" recommend fish oil

supplements compared to those that "sometimes" do when it comes to recommending increased MUFA intake for a heart healthy diet. However there was not a significant difference (p=.8532) between those who "most of the time" and "always" recommend the supplement. RDNs who "always" recommend fish oil to patients are 3 times more likely to recommend increased MUFA intake than those who "sometimes" recommend fish oil to recommend increased MUFAs. Similarly, respondents who use fat-free or reduced fat dairy substitutes "most of the time" are significantly different (p=.0024) than those who "always" use fat-free or reduced fat dairy substitutes. RDNs who "always" recommend fat-free or reduced fat dairy substitutes are 2 times more likely to recommend increased MUFA than those who "most of the time" make the same recommendation. All other comparisons using fat-free or reduced fat dairy substitutes were not significant (p>.05).

Lastly, a dependent variable regarding RDN recommendation of increased fish consumption for a heart healthy diet had a significant predictor (p=0.0273) of how often RDNs recommend a fish oil supplement. This was also a categorical dependent variable so the predictors are compared to the base levels from 1 (never) to 5 (always). The reference level was 5. RDNs who reported "always" recommending a fish oil supplement would be more likely to respond "yes" to recommending increased fish consumption. There were no significant differences comparing dietetic practice groups in level of confidence in explaining attributes of n-6 fatty acids as in the proposed (now newly released) 2015-2020 DGA.

Discussion

The nutritional perceptions, knowledge and personal habits of RDNs regarding dietary fat intake has been presented. With the possibility that varying dietary fat recommendations cause decreased perceived confidence among RDNs, researchers wanted to evaluate participant's confidence levels when making dietary fat recommendations along with knowledge of fat and the potential influence of personal dietary fat patterns. The newest proposed 2015-2020 Dietary Guidelines for Americans (DGA and now the newly released DGA 2015-2020) for fat appear to contribute to perceived confidence among RDNs for making fat recommendations. The 2015 DGA committee recommends that rather than focusing on reduction of sodium, saturated fat, and added sugars; emphasis should be placed on eating a healthy and balanced dietary pattern (Dietary Guidelines Advisory Committee, 2015). When the sample of RDNs were asked about the impact of the proposed 2015 Dietary Guidelines from the DGA Advisory Committee, 19.35% respondents agreed their confidence level was decreased for making dietary fat recommendations. However, 18.29% of RDNs disagreed that the proposed guidelines decreased their confidence level while making fat recommendations. Additionally, 51.97% neither agree nor disagree that their confidence level has been affected. No significant differences in knowledge or confidence was observed based on RDNs age group, level of education, and years of experience. Additionally, there were no significant differences between dietetic practice groups in level of confidence in explaining attributes of n-6 fatty acids as in the proposed (now newly released) 2015-2020 DGA.

Social and cultural factors have little influence on personal choices according to responding RDNs while some other factors such as taste influence dietary decision to a greater extent. However, when leading others in their dietary choices, the 2015-2020 Dietary Guidelines Strategy for Action states:

> "identification and addressing successful approaches for change includes knowledge of what constitutes healthy eating, enhancing access to adequate amounts of healthy, safe and affordable food (and beverage) choices, and promoting change within social and cultural norms to embrace, support and maintain healthy eating" (USDA & HHS, 2015).

The 2015-2020 Dietary Guidelines Strategy for Action is based on the Social Ecological Model (USDA, 2010 & USDA & HHS, 2015). It can be very difficult to force someone to shift their eating patterns unless you consider the foods they normally consume and then adjust accordingly.

The current study showed that RDNs make varying recommendations regarding dietary fat intake. RDNs were asked which fats should be avoided or limited in the general diet with 99.29% and 76.79% of RDNs agreeing that trans fatty acids and SFAs, respectively, should be avoided. Even though the national DGA committee and RDNs in this study agree that trans fatty acids and SFAs should be reduced, it is unclear as to what these calories should be replaced with to promote optimal nutrition. Jakobsen et al. (2009), noted a positive direct association between substituting MUFAs for SFAs and coronary events, but not coronary related deaths. As science based nutrition information is released, many RDNs strive to change Medical Nutrition Therapy accordingly (Academy of Nutrition and Dietetics AND, 2015b). The American Heart Association

(AHA) recommends at least 2 servings of n-3 fatty acid (7 ounces or 198.45 grams) per week (AHA, 2015a). A significant inverse relationship between substituting PUFAs for SFAs and coronary event risk and overall coronary death has been shown in the literature (Jakobsen et al., 2009). In addition, a direct negative association has been observed between carbohydrate substitution and risk of coronary events (Jakobsen et al., 2009).

When RDNs in this study were asked which fats contain potential health benefits, nearly 99% of the 280 RDN respondents agree that n-3 fatty acids have potential health benefits. Additionally 93.21% agree that MUFAS and 90.00% agree that essential fatty acids have potential health benefits. Furthermore, 77.14% indicated PUFAS, 60.00% stated n-6 fatty acids, and 18.93% SFAs have potential health benefits. Surprisingly, 98% of responding RDNs agreed that olive oil should be regularly utilized in food preparation however only 77% agreed that canola oil should be regularly utilized even though they are both MUFAs. As the proposed 2015-2020 DGA (now newly released 2015-2020 DGA) stated, fatty acids are needed for overall health and should not be avoided or isolated (Dietary Guidelines Advisory Committee, 2015). The 2015-2020 DGA are geared to embody the idea that a healthy eating pattern is not a rigid prescription, but rather, an adaptable set of guidelines to help people enjoy foods that meet their personal, cultural, and traditional preferences and fit within their budget (USDA & HHS, 2015). The responding RDNs may have been considering this recommendation when justifying which fatty acids have potential health benefits.

There appear to be discrepancies between RDN's nutritional knowledge regarding foods rich in n-3 fatty acids. Only 31.32% stated that lake trout is rich in n-3 fatty acids. Similar response rates of 72.60% agreed tuna and 72.24% stated that mackerel are rich in

n-3 fatty acids. However, 9.25% of respondents stated tilapia and 8.90% of respondents agreed that shrimp was rich in n-3 fatty acids. An average adult would need to consume approximately 104 ounces of tilapia to meet weekly recommendation of n-3 intake. Although shrimp is consumed more than any other fish or seafood in the U.S. diet (AHA, 2015a), just behind tuna, majority of shrimp is breaded and deep-fried and not a good source of n-3.

Especially for those that do not care for fish and seafood, n-3 supplements may be needed to meet n-3 recommendation. Supplementation of n-3 has been shown to decrease sudden death from CHD by 45 % in those who took EPA or DHA supplements (Academy of Nutrition and Dietetics AND, 2015). In the study designed in the Academy of Nutrition and Dietetics article, 37% of RDN respondents indicated personal use of the supplement whereas 63% responded they do not use the supplement in the current study. How often RDNs personally use a fish oil supplement was a significant predictor of fish oil recommendations. The respondent's odds of using a fish oil supplement increased 3.037 times for every increase in Likert-scale rating.

Regarding personal confidence levels of dietary fat consumption, 51.25% of RDN responders believe they follow the 2010 USDA Dietary Guidelines for fat and 65.84% feel they eat just the right amount of dietary fat. Additionally, 43.93% of RDNs agree they follow the 2010 USDA Dietary Guidelines for saturated fat and 46.43% feel they eat just the right amount of saturated fat daily. The 2010 Dietary Guidelines recommend 20-35% of calories come from dietary fat (USDA and HHS, 2010). According to previous research, most individuals in the U.S. consume approximately 33.0% of calories from dietary fat (CDC, 2014b). As previously stated, according to the Social Ecological model,

individual factors such as knowledge and skill are essential for making consumption choices. When not only the consumers, but also the nutrition experts, become unsure about their knowledge and skills (to make dietary recommendations and choices), an increase in poor choices may occur; alternatively, the entire food (e.g. fat) may be restricted or avoided (USDA, 2010).

Further research is needed to improve the understanding of RDN concerns and level of confidence regarding the tremendous variation and changing dietary fat guidelines. There are no identified studies that have examined the relationship of nutritional knowledge, perceptions and habits of RDNs regarding our dietary fat recommendations.

As in any self-reported survey, individual factors such as mood, lack of time, social commitments, and lack of validity of questions as worded may have influenced how questions were answered, affecting the overall study results. This study included personal questions such as dietary fat intakes, which may not have been reported accurately or truthfully.

Implications for Research and Practice

As professionals, RDNs have a key role in heading disease-prevention efforts within their organizations, their community and beyond—to make healthy eating an organizational and societal norm. Providing clear, consistent recommendations and solidarity regarding recommendations may increase RDN confidence levels when making dietary fat recommendations. Many organizations are promoting dietary fat recommendations such as the National Lipid Association (NLA), USDA Dietary Guidelines (DGA), and the American Heart Association (AHA).

The results of this study revealed that perceived confidence levels vary among RDNs regarding specific dietary fat recommendations for SFA, MUFA, and PUFA. In addition, nutritional knowledge related to specific dietary fatty acids and food sources also varied among RDNs. Nutritional knowledge varied regarding specific fat composition in fish. This may signify that lack of nutritional knowledge may contribute to varying recommendations.

Further research in regard to RDN impact on consumer confusion about dietary fat guidelines is warranted. Limited studies have been done on this topic. Now that the 2015-2020 DGA have been released, a repeated survey may result in improved confidence and knowledge.

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CHAPTER 5. CONCLUSION

This study was designed to examine perceptions, nutrition knowledge, and personal dietary patterns regarding fat intake among a random sample of RDNs. Examining RDN perceptions and nutritional knowledge regarding dietary fat in relation to our dietary fat guidelines may help with further research regarding customer confusion. Currently, many organizations such as the AHA, DGA committee, and NLA have varying fat recommendations. This may be contributing to decreased perceived confidence levels among RDNs when providing information to the general public. This research indicated many factors may influence dietary fat recommendations such as personal preference, health factors, and knowledge. As noted, the proposed dietary fat guidelines were released with alterations to the previous guidelines such as having an emphasis on adequate fat consumption rather than having a lower fat diet. This study focused on whether RDN's confidence levels and personal consumption choices affected their dietary fat recommendations.

The hypothesis of this study was that the level of confidence among RDNs is affected by the varying dietary fat guidelines among the different organizations. The results of this study did support our hypothesis. Many of the RDNs indicated the proposed 2015 dietary recommendations decreased their confidence level when making dietary fat recommendations. This study also revealed that many RDNs have varying recommendations regarding potential health benefits of fatty acids, n-3 rich foods, and avoidance of different fatty acids.

Additionally, RDNs who personally use a fish oil supplement were more likely to recommend a fish oil supplement than those who do not use a supplement. This direct

relationship indicates that there may be a relationship in personal consumption choices to dietary fat recommendations. Also, RDNs who always recommend fish oil to patients are more likely than those who sometimes recommend fish oil to recommend increased MUFAs.

Major limitations for the study include lack of gender variation in the sample with nearly 97% of the participants reported as female. Additionally, this study was performed nationally where varying food products are available (e.g. fresh fish). Frequency questions regarding how often low-fat products are used was asked; however consideration about specific food items being consumed every week was not questioned. For example, use of fat-free or salad dressing was assessed on a weekly basis; however, respondents may not eat a salad each week.

Future research examining dietary practices and knowledge regarding dietary fat among the general public consumers may be beneficial to assess confusion level. This study showed that RDNs have varying perceived confidence levels when making dietary fat recommendations. It is unclear if the varying recommendations by RDNs cause confusion among the consumer.

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APPENDIX A. EMAIL GREETING

North Dakota State University
Health, Nutrition, & Exercise Sciences
NDSU Dept 2620
PO Box 6050
Fargo, ND 58108-6050
701.231.7479

Is it time to reevaluate our dietary fat guidelines?

My name is Nicole Vasichek. I am a graduate student in Exercise Science & Nutrition at North Dakota State University, and I am conducting a research project to learn about Registered Dietitian Nutritionists' (RDN's) perceptions, nutritional knowledge, behavioral habits, and recommendations regarding dietary fat intake in relation to our current dietary fat guidelines. It is our hope, that with this research, we will benefit current/future health professionals as these results may guide future educational materials regarding dietary fat.

You are invited to take part in this survey based research project. The only criterion for participation in this study is that you must be a RDN. Your participation is entirely your choice, and you may change your mind or quit participating at any time, with no penalty to you; however, your assistance would be greatly appreciated in making this a meaningful study.

It should take less than 15 minutes to complete the survey on methods of presenting nutrition information regarding dietary fat. To complete the survey please click on the link below.

One of the first 150 responders will have the opportunity to provide his or her e-mail address for a chance to win a $20 Amazon.com gift card. The e-mail address provided will not be connected to any survey questions.

Personal email addresses will not be linked to survey responses. The information you provide on the survey will be combined with information from other people taking part in the study. We will write about the combined information that we have gathered. We may publish the results of the study; however, we will keep your name and other identifying information private.

Please **click the link below** to proceed to the informed consent.
https://ndstate.co1.qualtrics.com/SE/?SID=SV_1SmPdXt1TmOVp8F

APPENDIX B. INFORMED CONSENT

NDSU North Dakota State University
Health, Nutrition, & Exercise Sciences
NDSU Dept 2620
PO Box 6050
Fargo, ND 58108-6050

Is it time to reevaluate our dietary fat guidelines?

Purpose of Research:
The purpose of this study is to explore Registered Dietitian Nutritionists' (RDN's) perceptions, nutritional knowledge, behavioral habits and recommendations regarding dietary fat intake in relation to our current dietary fat guidelines. Participation in this study will involve completing an online survey through Qualtrics®.

Participation:
Completing this survey is voluntary. The survey should take 15 minutes or less to complete. The survey will be open until September 15, 2015. You may choose to not participate. All questions can only be answered once and you may opt out at any time during the survey without penalty.

Benefits and Risks:
There is no direct benefit to you from participating in this research. This research may benefit current/future health professionals as survey results may guide future educational materials regarding dietary fat. There is very limited risk to participate. The survey results will be kept confidential within the survey team, but loss of confidentiality is a minimal risk.

Confidentiality:
All answers and information provided by completing the survey will be confidential. The results of the survey will be included as part of a master's thesis by Nicole Vasichek, RDN, LRD, and NDSU graduate student. All data presented will have no identifiers linking it to any participant.

Survey Completion:
At the completion of the survey, the **first 150 responders** will have the opportunity to provide their e-mail addresses for a chance to win one $20 Amazon.com gift card. The e-mail address provided will not be connected to the survey question answers.

Additional Questions or Concerns:
Should you have any questions or concerns related to this survey or research project, please contact Nicole Vasichek, RDN, LRD at Nicole.e.vasichek@ndsu.edu, phone # (701) 270-0543 or faculty advisor Sherri Stastny, Ph.D., RD, CSSD, LRD at Sherri.Stastny@ndsu.edu, phone # (701) 231-7479. If you have questions about the rights of human participants in research, or if you would like to report a complaint about this

research, contact the NDSU Human Research Protection Program, at 701.231.8995, or toll free: 1-855-800-6717 or ndsu.irb@ndsu.edu.research, contact the NDSU Human Research Protection Program, at 701.231.8995, or toll free: 1-855-800-6717 or ndsu.irb@ndsu.edu.

APPENDIX C. FAT FACTS SURVEY

Demographic Information

Please note that all questions can only be answered once; the survey cannot backtrack.

1. What is your primary area of practice?
    a. Clinical nutrition – acute care/inpatient
    b. Clinical nutrition – ambulatory care
    c. Clinical nutrition – long-term care
    d. Community
    e. Food and nutrition management
    f. Consultation and business
    g. Education and research
    h. Other:_____

2. Your Age
    Under 18 _____ (survey shuts down)
    18-24 _____
    25-39 _____
    40-60 _____
    61 or older _____

3. Which gender are you?
    a. Male
    b. Female
    c. I do not wish to disclose

4. What is your highest level of education? (any major)
    a. Bachelor's Degree
    b. Master's Degree
    c. Doctorate Degree

5. Years of practice as a Registered Dietitian Nutritionist (RDN)
    a. Less than 5 years _____
    b. 5 – 10 years _____
    c. 11 – 15 years _____
    d. 16 – 20 years _____
    e. 21 – 25 years _____
    f. 26 – 30 years _____
    g. More than 30 years _____

6. Identify memberships in Dietetic Practice Groups (DPGs) (Select all that apply)
    ___ Behavioral Health Nutrition
    ___ Clinical Nutrition Management

___ Diabetes Care and Education (DCE)
___ Dietetic Technicians in Practice
___ Dietetics in Health Care Communities
___ Dietitians in Business and Communications (DBC)
___ Dietitians in Integrative and Functional Medicine
___ Dietitians in Nutrition Support (DNS)
___ Food & Culinary Professionals (FCP)
___ Healthy Aging
___ Hunger and Environmental Nutrition
___ Management in Food and Nutrition Systems
___ Medical Nutrition Practice Group
___ Nutrition Education for the Public (NEP)
___Nutrition Educators of Health Professionals (NEHP)
___Nutrition Entrepreneurs (NE)
___Oncology Nutrition
___Pediatric Nutrition
___Public Heath/Community Nutrition
___Renal Dietitians
___Research
___School Nutrition Services
___Sports, Cardiovascular and Wellness Nutrition (SCAN)
___Vegetarian Nutrition
___Weight Management
___Women's Health
___ Other_____

Dietary Patterns

The following question is regarding the general public

7. Indicate your level of agreement that the following fats should be regularly utilized in food preparation (5 = strongly agree, 1 = strongly disagree)

   a. Olive oil
      5 4 3 2 1

   b. Canola oil
      5 4 3 2 1

   c. Vegetable oil (soybean, corn, etc.)
      5 4 3 2 1

   d. Vegetable oil spray (e.g. PAM)
      5 4 3 2 1

   e. Butter
      5 4 3 2 1

f. Margarine
5 4 3 2 1

g. Coconut oil
5 4 3 2 1

h. Other fat:_____
5 4 3 2 1

The following questions are regarding your personal dietary habits:

Please indicate your level of agreement to the following statement

8. I feel confident that I follow the 2010 (most recent) USDA Dietary Guidelines for fat intake (20 - 35% of calories from fat)?

    a. Strongly agree
    b. Agree
    c. Neither agree nor disagree
    d. Disagree
    e. Strongly disagree

9. Do you feel confident that you:

    a. Eat less than the recommended amount of dietary fat (less than 20 - 35% of calories from fat)
    b. Eat "just the right" amount of dietary fat (20 - 35% of calories from fat)
    c. Eat more than the recommended amount of dietary fat (more than 20 - 35% of calories from fat)

10. Do you feel confident that you follow the 2010 (most recent) USDA Dietary Guidelines for saturated fat (less than 10% of calories from saturated fat)?
    a. Strongly agree
    b. Agree
    c. Neither agree nor disagree
    d. Disagree
    e. Strongly disagree

11. Do you feel confident that you:

    a. Eat less than the recommended amount of saturated fat (less than 10% of calories from saturated fat)
    b. Eat "just the right" amount of saturated fat (near 10% of calories from saturated fat)
    c. Eat more than the recommended amount of saturated fat (more than 10% of calories from saturated fat)

12. What do you perceive to be the benefits of coconut oil? (Select all that apply)

    a. Increased satiety
    b. Improved levels of total serum cholesterol
    c. Improved levels of serum LDL cholesterol (e.g., lower LDL)
    d. Improved skin and hair
    e. I do not believe coconut oil has benefits
    f. I have not heard of coconut oil as a beneficial fat
    g. Other:_____ (free text)

13. Do you use a fish oil supplement?
    a. Yes
    b. No

14. How often do you recommend a fish oil supplement to your clients, patients or others?

    a. Always
    b. Most of the time
    c. Sometimes
    d. Rarely
    e. Never

Please explain your answer_____ (free text)

Consumption Choices

When making personal food choices...

15. Indicate the level of importance of the following factors when choosing the type of fat you consume?
    (5 = very important, 1 = not important at all)

    a. Taste
       5 4 3 2 1

    b. Social, Cultural
       5 4 3 2 1

    c. Health
       5 4 3 2 1

    d. Nutrition
       5 4 3 2 1

    e. Convenience
       5 4 3 2 1

f. Cost
5 4 3 2 1

g. Other:_____
5 4 3 2 1

16. How important is amount of dietary fat per serving to you when making food choices? (5 = very important, 1 = not important at all)

5 4 3 2 1
Please explain your answer: _____ (free text)

17. a. When purchasing processed foods, how often do you use low-fat products?

a. Always (>5 days per week)
b. Most of the time (3 – 4 days per week)
c. Sometimes (2 days per week)
d. Rarely (1 day per week)
e. Never

17 b. How often do you use fat-free or reduced fat salad dressing?

a. Always (>5 days per week)
b. Most of the time (3 – 4 days per week)
c. Sometimes (2 days per week)
d. Rarely (1 day per week)
e. Never

17 c. How often do you use fat-free or reduced fat dairy products?

a. Always (>5 days per week)
b. Most of the time (3 – 4 days per week)
c. Sometimes (2 days per week)
d. Rarely (1 day per week)
e. Never

17 d. How often do you use fat-free or reduced fat dairy substitutes, such as creamers?

a. Always (>5 days per week)
b. Most of the time (3 – 4 days per week)
c. Sometimes (2 days per week)
d. Rarely (1 day per week)
e. Never

17 e. How often do you use other fat-free or reduced fat foods (free text)? (5= always, 1= never)

5 4 3 2 1

18. Do you have any health conditions (e.g. coronary heart disease, diabetes, high cholesterol) that affect your decisions about your personal dietary fat consumption? (Select all that apply)

    a. Yes
        i. What type?_____
        *Pull down list
        coronary heart disease, hypertension, obesity, diabetes, high blood pressure, high cholesterol, high LDL cholesterol)
    b. No

Nutrition Knowledge (these headings will not be included as part of Qualtrics survey)

19. Which foods are rich in Omega-3 fatty acids? (Select all that apply)

    a. Salmon
    b. Tilapia
    c. Shrimp
    d. Tuna
    e. Lake trout
    f. Mackerel
    g. Other:_____ (free text)

20. A. For the following list, indicate your level of confidence in explaining food sources of each fat? (5 = Very confident, 1= Very unsure)
    a. Omega-3 fatty acids
       5 4 3 2 1
    b. Omega-6 fatty acids
       5 4 3 2 1
    c. Essential fatty acids
       5 4 3 2 1
    d. Polyunsaturated fats
       5 4 3 2 1
    e. Monounsaturated fats
       5 4 3 2 1
    f. Trans fatty acids
       5 4 3 2 1
    g. Saturated fats
       5 4 3 2 1
    h. Other: _____ (free text)

5 4 3 2 1

20 B. For the following list, indicate your level of confidence in explaining each fat's effects on health? (5= Very confident, 1= Very unsure)

a. Omega-3 fatty acids
   5 4 3 2 1
b. Omega-6 fatty acids
   5 4 3 2 1
c. Essential fatty acids
   5 4 3 2 1
d. Polyunsaturated fats
   5 4 3 2 1
e. Monounsaturated fats
   5 4 3 2 1
f. Trans fatty acids
   5 4 3 2 1

20 C. For the following list, indicate your level of confidence in explaining each fats nutrition attributes? (5= Very confident, 1= Very unsure)

a. Omega-3 fatty acids
   5 4 3 2 1
b. Omega-6 fatty acids
   5 4 3 2 1
c. Essential fatty acids
   5 4 3 2 1
d. Polyunsaturated fats
   5 4 3 2 1
e. Monounsaturated fats
   5 4 3 2 1
f. Trans fatty acids
   5 4 3 2 1

21. Which fats have potential health benefits? (Select all that apply)
    a. Omega-3 fatty acids
    b. Omega-6 fatty acids
    c. Essential fatty acids
    d. Polyunsaturated fats
    e. Monounsaturated fats
    f. Trans fatty acids
    g. Saturated fatty acids
    h. Other:_____ (free text)

22. Which fats should be avoided or limited in the general diet? (Select all that apply)
    a. Omega-3 fatty acids

b. Omega-6 fatty acids
c. Essential fatty acids
d. Polyunsaturated fats
e. Monounsaturated fats
f. Trans fatty acids
g. Saturated fatty acids
h. Other:_____ (free text)

23. Indicate your level of confidence in choosing foods that contain fats that are associated with health benefits:

Very confident Confident Neutral Unsure Very Unsure

24. Indicate your level of agreement with the following statement:
Given all the recent changes in information regarding the proposed 2015 Dietary Guidelines for fat from the Dietary Guidelines Advisory Committee, I am less confident in making recommendations regarding dietary fat

Strongly Agree Agree Neutral Disagree Strongly Disagree

25. Of the diets described below, which one fits your current typical diet recommendation for cardiac patients or others who seek "heart healthy" diets? (Select all that apply)
____ Low-fat diet
____ Moderate fat diet
____ Increased monounsaturated fat
____ Increased fish consumption
____ Increased polyunsaturated fat
____ Decrease saturated fatty acids
____ Avoid trans fatty acids
____ 20 - 35% of calories from fat
____ Do not make fat intake recommendations
____ Other_____ (free text)

26. Please read the following paragraph regarding fat facts; then, answer the question at the end:

Dietary fat has many important health functions, and dietary fat intake is important for maintaining healthy cells, skin and eyes, and cognitive development; in addition, it contributes to meal satiety. However, studies have found that excessive fat intake is related to weight gain and heart disease; they have also found increased intake of solid animal and trans fatty acids contribute to increased levels of serum LDL cholesterol. By replacing trans fatty acids and saturated fatty acids with monounsaturated and other healthier fats, we can contribute to overall health while maintaining a satisfying diet.

Based on the above, what action(s) do you think you should take to improve your personal dietary intake regarding fat intake? (select all that apply)

a. Decrease overall dietary fat
b. Decrease trans fatty acids
c. Decrease saturated fatty acids
d. Increase polyunsaturated fat
e. Increase monounsaturated fat
f. Eat fat in moderation
g. Eat plenty of fat—all kinds are ok
h. No change
i. Other _____(free text)

27. As you consider updates to nutrition education materials, how likely are you to update your dietary fat recommendation education materials in the next six months?

    Very Likely Likely Not very likely Not likely at all Not applicable

    Please explain your answer._____(free text)

APPENDIX D. CDR PERMISSION

From: Pearlie Johnson **Sent:** Tuesday, August 25, 2015 11:25 AM **To:** 'nicole.vasichek@gmail.com' <nicole.vasichek@gmail.com> **Subject:** RE: Master's Thesis Student seeking Listserv info.

Hi Nicole, your request has been reviewed and approved. We will send you the list of RDNs by end of day Thursday, August 27, 2015.

Thank you.

Pearlie Johnson-Freeman, MBA
Director, Credentialing Services

Commission on Dietetic Registration
the credentialing agency for the
Academy of Nutrition and Dietetics
120 South Riverside Plaza, Suite 2000
Chicago, IL 60606-6995
phone: 312-899-4839
fax: 312-899-4772
pjohnson@eatright.org

APPENDIX E. IRB APPROVAL

NDSU NORTH DAKOTA STATE UNIVERSITY

July 31, 2015

Dr. Sherri Stastny
Health, Nutrition & Exercise Sciences
EML Room 351

Re: IRB Certification of Exempt Human Subjects Research:
Protocol #HE16014 , "Is it time to reevalaute our dietary fat recommendations?"

Co-investigator(s) and research team: Nicole Vasichek, Jill Keith

Certification Date: 7/31/2015 Expiration Date: 7/30/2018
Study site(s): varied, online
Sponsor: n/a

The above referenced human subjects research project has been certified as exempt (category # 2) in accordance with federal regulations (Code of Federal Regulations, Title 45, Part 46, Protection of Human Subjects). This determination is based on the original protocol submission (received 7/30/2015).

Please also note the following:
- If you wish to continue the research after the expiration, submit a request for recertification several weeks prior to the expiration.
- The study must be conducted as described in the approved protocol. Changes to this protocol must be approved prior to initiating, unless the changes are necessary to eliminate an immediate hazard to subjects.
- Notify the IRB promptly of any adverse events, complaints, or unanticipated problems involving risks to subjects or others related to this project.
- Report any significant new findings that may affect the risks and benefits to the participants and the IRB.

Research records may be subject to a random or directed audit at any time to verify compliance with IRB standard operating procedures.

Thank you for your cooperation with NDSU IRB procedures. Best wishes for a successful study.
Sincerely,
Kristy Shirley

Kristy Shirley, CIP, Research Compliance Administrator

For more information regarding IRB Office submissions and guidelines, please consult http://www.ndsu.edu/research/integrity_compliance/irb/. This Institution has an approved FederalWide Assurance with the Department of Health and Human Services: FWA00002439.

INSTITUTIONAL REVIEW BOARD
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