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THE USE AND KNOWLEDGE OF OLIVE OIL AND OTHER LIPIDS IN A COLLEGIATE STUDENT POPULATION

By

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A Thesis Submitted to the Graduate Faculty in the Division of Nutrition at Georgia State University in Partial Fulfillment of the Requirements for the Degree

MASTER OF SCIENCE
SCHOOL OF HEALTH PROFESSIONS
DIVISION OF NUTRITION
GEORGIA STATE UNIVERSITY

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ATLANTA, GEORGIA
2010

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By

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DEDICATION

This thesis is dedicated to Candice Andrews, who has been always my best friend, my supporter and my listener. You have taught me that even the impossible can be accomplished if I put all my passion and energy into it. Your infinite friendship and laughter always make me enjoy life. This thesis is also dedicated to the most beautiful people, my parents, and my sister Myriam. Parents, you always have given me the energy and emotional support that I need to achieve my goals. Thank you for all your guidance. Myriam, you were always here to listen to me and to give me the best advice in moments of doubt. Thank you for believing in me. Without all of you, I would not have accomplished my objectives.

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ABSTRACT

Purpose: Evidence suggests that olive oil consumption is associated with a decreased prevalence of cardiovascular disease and certain cancers. The purpose of this study was to assess the intake and knowledge of olive oil and other lipids in a collegiate population.
Methods: Using an IRB-approved protocol, volunteered college students (N=56) from the college of Health and Human Sciences at Georgia State University completed a questionnaire on lipid and knowledge and eating behavior. Results were assessed to determine if students were able to accurately answer questions on the contents of different lipids, and also to determine the consumption behaviors of different lipids. Statistical comparisons were made between undergraduate and graduate students, and between students in different academic majors (nutrition, nursing, respiratory therapy, social work, criminal justice, and other).
Results: It was hypothesized that eating behaviors would overemphasize unhealthy lipids. Lipids assessed included: olive oil, butter, canola oil, peanut oil, corn oil, margarine, sunflower oil, and soybean oil. There were no statistically significant differences between the ratios of consumed lipids labeled as 'good', and lipids labeled as 'bad'. There were also no statistically significant differences in the presence of 'good' to 'bad' lipids in the subjects' kitchens. Therefore, the results of this study were not able to disprove the null hypothesis. Nevertheless, using a Likert scale response scheme, there was a difference ($p=0.041$) between academic majors in the consumption of canola oil (an oil high in monounsaturated fatty acid), with Nursing majors reporting the highest consumption ($X=3.73$; $SD=1.61$) and Respiratory Therapy majors reporting the lowest consumption ($X=1.89$; $SD=1.53$). There was no statistically significant difference between graduate and undergraduate students in the presence of lipids in the kitchen.
It was hypothesized that subject knowledge of lipid constituents would be poor. The majority of subjects either failed to respond correctly to the constituents of different lipids or reported that they did not know. Based on this result, the study is able to reject the lipid knowledge null hypothesis. There were clear differences in subgroup knowledge of commonly consumed lipids. Most notably, 100% of nutrition students responded correctly to the constituents of olive oil.
Conclusions: This study focused on a group of college students in the College of Health and Human Sciences. One might assume that such a population would be sensitive and knowledgeable about key dietary factors that may influence disease risk. Nevertheless, these findings indicate that, except for isolated exceptions, the eating behaviors and lipid knowledge of these students is not at a level that could be considered health promoting. This suggests that, even with students in the health sciences, personal health classes are likely to be beneficial in reducing disease prevalence.

TABLES OF CONTENTS

List of Tables	IX
Abbreviations	X
Review of Literature	1
Methods	22
Results	24
Discussion	50
Conclusion	54
References	57
Appendix A: Questionnaire	61
Appendix B: IRB approval	69
Appendix C: Phenolic Compounds	70

LIST OF TABLES

Table 1:
Consumption of olive oil and production 77

Table 2:
Olive oil sales in US markets 77

Table 3:
Frequency of consumption of different oils 78

Table 4:
Different cooking methods using different fats 79

Table 5:
Frequency of purchase of common foods 80

ABBREVIATIONS

OA	Oleic Acid
CJ	Criminal Justice
CVD	Cardiovascular Diseases
F	Female
GRAD	Graduate
M	Male
MUFA	Monounsaturated Fatty Acids
NURS	Nursing
NUTR	Nutrition
OTH	Other
oxLDL	Oxidatively Modified LDL
PUFA	Polyunsaturated Fatty Acids
ROS	Reactive Oxygen Species
RT	Respiratory Therapy
SW	Social Works
TOTAL	Total subjects
UND	Undergraduate
vWF	Von Willebrand Factor

CHAPTER I

INTRODUCTION

The olive tree, *Olea Europaea*, is native to the Mediterranean basin and parts of Anatolia (Western Asia). There is evidence that olive oil, which is produced from the compressed fruits of the olive tree, may have powerful therapeutic benefits. In addition, there are number of studies on the Mediterranean-style diet that support the olive oil potential for reducing oxidative damage associated disease risks. Oleic acid and phenolic compounds, both of which are bioavailable to humans are the active olive oil components that may enhance health and reduce disease risk. Phenolics, which occur in abundant levels in olive oil, have antioxidant activity while oleic acid is associated with lower cancer risk. In addition, there is evidence that olive oil and its components may reduce the risk of coronary heart disease, high blood pressure and hyperlipoproteinemia.

Oleic Acid

Oleic acid, a monounsaturated omega-9 fatty acid is found in various animal and vegetable sources. Approximately 55-80% of olive oil is composed of oleic acid. The single double bond of oleic acid makes it more stable to oxidation (Machowetz et al., 2007; Tripoli et al., 2005). A study has established that oleic acid intake might suppress the over-expression of some oncogenes, which play a key role in the etiology of several human cancers, including breast, ovarian, and gastric carcinomas (Menendez et al.,

2006). Furthermore, oleic acid oil intake positively affects the human immune system and certain inflammatory disorders (Puertollano et al., 2007).

Phenolic Compounds

Phenolic constituents in olive oil can be divided in three categories: simple phenols, secoiridoids and lignans (Fabiani et al., 2006). The major phenols include hydroxytyrosol, tyrosol, oleuropein, and ligstroside (Fabiani et al., 2006). These phenolic compounds have antioxidant activity, which enable them to reduce the potentially damaging effects of free radicals, such as peroxide (Machowetz et al., 2007). There is also evidence that phenols may exert protective action against carcinogenesis. One study showed that a mixture of phenolic compounds isolated from olive oil prevented proliferation and induced apoptosis in the human leukemia cell line HL60 (Fabiani et al., 2006).

Mediterranean Diet

The Mediterranean diet contributes to better health and quality of life for those who follow it (Tur et al., 2004). The diet is characterized by a relatively high intake of fruits, vegetables, nuts, olive oil, fish and a low intake of saturated fat. Even though the Mediterranean diet is consumed in the large parts of the Mediterranean Basin, a progressive change from this typical diet is observed. An epidemiological study demonstrated that some Mediterranean countries have increased their consumption of animal products and saturated fat. However, olive oil persists as the main dietary fat in the Mediterranean region, which may explain the low prevalence of chronic disease in

those countries (Psaltopoulou et al., 2004). Also, an estimate of dietary fat intake has demonstrated that the consumption of unhealthy dietary fat, such as trans-fatty acids differs considerably in various countries throughout the world; Mediterranean countries show the lowest intake of trans-fatty acids.

There is considerable evidence to suggest that the Mediterranean diet is associated with a decreased prevalence of cardiovascular disease and certain cancer types, despite the fact that this diet is higher in fat than the typical Western diet. An important component of the Mediterranean diet, and a possible reason for this disease prevalence difference, may be the source of fat, which is primarily from olive oil. The high level of oleic acid is believed to contribute to the low incidence of chronic disease (Psaltopoulou et al., 2004). Studies comparing different levels of olive oil consumption have provided evidence that olive oil may have health benefits, which include a reduction in high blood pressure and lower risk of breast and colon cancers (Psaltopoulou et al., 2004). Based on results of these epidemiological studies, in vitro studies have been designed to identify how olive oil exerts its effects at the cellular level.

Summary

Olive oil ingredients have been show to be effective in lowering the level of oxidative DNA damage (Machowetz et al., 2007; Psaltopoulou et al., 2004; Stark et al., 2002). These studies have increased the interest in the health promotion properties of olive oil. The purpose of this thesis is to evaluate the students' eating behaviors and knowledge of lipids, and to review the literature on the health benefits of olive oil.

HYPOTHESES

Hypothesis1: The eating behavior of the tested population will demonstrate a relatively overconsumption of unhealthy dietary fats and an under- consumption of olive oil.

> Null Hypothesis 1: The eating behavior of the tested population will demonstrate a relatively low consumption of unhealthy dietary fats and a relatively high consumption of olive oil

Hypothesis 2: The tested population will demonstrate a lack of knowledge of lipid contents.

> Null Hypothesis 2: The tested population will demonstrate a high level of knowledge lipid contents.

CHAPTER II

REVIEW OF LITERATURE

Introduction

Olive oil, a product of the mechanical extraction from the fruit of Olea Europeae, is composed mainly of the mixed triglyceride esters of oleic acid and palmitic acid and phenolic compounds with traces of squalene (up to 0.7%) and sterols (about 0.2% phytosterol and tocosterols). The composition of olive oil varies by cultivar, region, altitude, time of harvest, and extraction process. Olive oil is a foodstuff with a wide range of healthy effects typical of functional foods. Some of these effects are related to its high content of monounsaturated fat (MUFA) and phenolic compounds.

Approximately one third of all cancers can be attributed to diet and could be reduced by individual improvements in diet and societal attention to the quality of the food (Escrish et al., 2007). Evidence from epidemiological studies suggests that a higher proportion of MUFA in the diet is linked with a reduction in the risk of cancer and chronic diseases (Escrish et al., 2007). This is significant because olive oil is considerably rich in MUFA, most notably oleic acid.

Oleic Acid and Cancer

Diets rich in olive oil have health benefit, primarily due to oleic acid, the main MUFA in olive oil. Studies have reported that oleic acid plays a role in cancer prevention due to the effect of the fatty acid on oil stability that prevents oxidative stress (Menendez et al., 2006). Oxidative stress is defined as an imbalance between the oxidant and antioxidant systems of the body, in favor of the oxidant. *In vitro* and *in vivo* experiments have looked at the effect of oleic acid on cancer. These studies have established that oleic acid might suppress the over-expression of 'h*uman epidermal growth factor receptor 2*' *(HER2)*, an oncogene involved in the etiology and metastasis of several human cancers (Menendez et al., 2006). In addition, oleic acid appears to work well in reducing the risk of several types of cancers, including breast, ovarian, and gastric carcinomas (Menendez et al., 2006).

It is currently accepted that 20% to 60% of cancers, depending on the anatomic localization of the tumor, are avoidable through diet, and fat had been extensively examined. Epidemiological studies showed that women who consume a diet high in dietary fat have a risk of breast cancer that can be five-fold higher than that of women who consume a diet low in dietary fat (Menendez et al., 2006). The incidences of cancers of the colon and the breast are considerably lower in southern European countries such as Italy, Greece and Spain, where the Mediterranean diet is consumed, than in northern European countries where diets are high in polyunsaturated fatty acids (PUFAs) (Menendez et al., 2006).

Research in experimental animals has yielded evidence about the protective effect of olive oil against cancer. The protective effect of olive oil occurs with the initiation stage of cancer; olive oil prevents oxidative DNA damage or DNA strand breakage (Perez-Jimmenez et al., 2005). Associations between high consumption of olive oil and decreased risk of breast, colon, and rectum, oral, pharyngeal, laryngeal, and esophageal cancer have been established (Machowetz et al., 2007). These findings are supported by the observation that lifelong feeding of MUFA rich olive oil leads to a lower level of oxidative DNA damage when compared with PUFA rich oil (Machowetz et al., 2007). Accumulation of mutations from oxidative DNA damage is considered a crucial component of human carcinogenesis (Machowetz et al., 2007).

Oleic Acid and Cardiovascular Disease

Diet is also a risk factor for cardiovascular disease. Dietary interventions have demonstrated that adoption of a Mediterranean diet reduces cardiovascular risk and mortality in patients after a first cardiovascular event. The classic studies of Angel Keys and colleagues introduced the health protective effects of the Mediterranean diet to the scientific community (Vialettes et al., 1992). The Lyon heart study, a prospective, randomized study compared the usually recommended low fat diet, high in n-6 PUFA, to a Mediterranean type diet rich in oleic acid for prevention of coronary heart disease. The number of patients with non-fatal myocardial re-infarction or cardiac death was 70% lower in the Mediterranean group than in control group, demonstrating a very impressive preventive effect of the Mediterranean diet in this high risk population (Escrish et al., 2007).

Oleic acid is also a predominant fatty acid in foods of animal origin, specifically poultry and pork. Thus, the percentage of oleic acid in the Mediterranean diet is only marginally higher than Western diets. It is, therefore, unlikely that oleic acid is exclusively accountable for the healthful properties of olive oil. Although the healthy effects of a high proportion of oleic acid intake should not be overlooked, what really sets olive oil apart from other vegetable oils is its content of other substances (Visioli et al., 2005).

Phenolic Compounds

The pulp of olives contains phenolic compounds, which are hydrophilic substances found in the oil. The class of phenolic compounds includes numerous substances, including caffeic acids, tyrosol and hydroxytyrosol, and more complex compounds such as oleuropein, ligstroside, and the lignans. The main antioxidants of olive oil are the phenolic compounds. They are at least thirty-six structurally distinct phenolics that have been identified in virgin olive oil (see appendix C). Not all phenolics are present in all virgin olive oils and there is variation in the phenolic concentration among virgin olive oils.

Historically, the healthful properties of virgin olive oil were attributed to a high proportion of MUFAs, namely oleic acid; yet, several seed oils rich in MUFA have been ineffective in altering chronic disease factors (Cicerale et al., 2009). Because virgin olive oils contain significant phenolic component that other seed oils lack, the phenolic fraction of virgin olive oil has generated much interest. Studies have demonstrated that olive oil

phenolics have positive effects on certain physiological traits, such as reducing the risk of chronic disease development (Cicerale et al., 200913).

Olive oil phenolics are highly bioavailable, further supporting their health promoting effects. Experiments have found that humans absorb a major part of the dietary olive oil phenolics they consume (Cicerale et al., 2009). Tyrosol and hydroxytyrosol, major olive oil phenolic compounds present as simple forms or conjugates, rise early after olive oil ingestion and are absorbed in a dose dependent manner (Fito et al., 2007; Reinish et al., 1998).

Phenolic compounds: Absorption

Animal and in vitro studies suggest that olive oil phenols such as tyrosol and hydroxytyrosol are effective antioxidants (Vissers et al., 2002). The Mediterranean diet rich in olive oil supplies about 10-20 mg of phenols per day (Visioli et al, 1995). An in vitro study in cells showed that hydroxytyrosol was transported via passive diffusion in a dose dependent manner (Manna et al., 2000). Another human study showed that tyrosol and hydroxytyrosol were excreted in urine and that these olive oil phenols were absorbed in the intestine after ingestion, but it was unclear to what extent (Visioli et al, 1995).

An important step in human metabolism of olive oil phenols might be the splitting of oleuropein and ligstroside into hydroxytyrosol and tyrosol. This was supported by some findings that 15 mol/100 mol of an oleuropein supplement was excreted in urine as tyrosol and hydroxytyrosol (Vissers et al., 2002). Oleuropein and ligstroside might be

split either in the gastrointestinal tract before they are absorbed or in the intestinal cell, blood, or liver after they are absorbed. The human body seems able to hydrolyze oleuropein and ligstroside into hydroxytyrosol and tyrosol and to metabolize these phenols widely, after absorption from the small intestine (Vissers et al., 2002).

Phenolic compounds: Effects on plasma lipoproteins

Olive oil phenolics have been found to favorably alter the proportion of LDL and HDL in humans. In one human study, the consumption of virgin olive oil rich in phenolics led to a significant decrease in LDL after one week of consumption (Cicerale et al., 2009). In parallel, animal studies have demonstrated that olive oil phenolics possess beneficial lipid modulating abilities (lowering LDL and triglycerides) (Cicerale et al., 2009). These lipid modulating abilities of olive oil phenolics may in part explain the low incidence of arthrosclerosis and cardiovascular diseases (CVD) among Mediterranean populations (Cicerale et al., 2009).

Elevated serum LDL level is considered characteristic for atherosclerosis and CVD development. Oxidatively modified LDL (oxLDL) damage the vascular wall, which stimulates macrophage uptake and formation of foam cells. The foam cells are involved in plaque formation. Human and animal studies have shown that the degree of oxLDL in vivo decreases as the phenolic content in the administrated olive oil increases (Cicerale et al., 2009).

Similarly, studies have shown that oxidative stress provokes the onset of atherosclerosis by inducing lipid peroxidation (Tripoli et al., 2005). Antioxidants that prevent lipid peroxidation have an important role in preventing oxidative modification of LDL. Human LDL contains a variety of antioxidants capable of inhibiting peroxidation. Alpha Tocopherol (vitamin E) is the most abundant antioxidant in LDL (Tripoli et al., 2005). On the basis of previous epidemiological studies pointing out the direct correlation between the Mediterranean diet and a lower incidence of cardiovascular diseases, studies performed in vivo and in vitro have shown that the polyphenolic compounds of olive oil play an important role in the prevention of atherosclerosis damage through their inhibition of LDL oxidation (Masella et al., 1999; Tripoli et al., 2005). In a sample of LDL, the vitamin E oxidation was prevented by the addition of hydroxytyrosol; this effect was linearly correlated with the hydroxytyrosol concentration (Tripoli et al., 2005). In LDL, the addition of polyphenolics compounds caused significant reduction in lipid peroxide formation. In LDL not treated with polyphenolic compounds, lipid peroxides are formed at the same rate as the reduction of vitamin E levels (Tripoli et al., 2005). That said, phenolic compounds delay the beginning of the oxidative process, preserving the endogenous antioxidant pool (Tripoli et al., 2005).

Phenolic compounds: Effects on oxidative damage to DNA and cellular function

Human cells are continuously attacked by oxygen radicals; if not appropriately attenuated, these radicals damage DNA and promote mutations that lead to cancerous formation (Cicerale et al., 2009). Data from a controlled human intervention trial demonstrated that the consumption of virgin olive oil containing phenolic compounds

significantly reduced DNA oxidation (Reinish et al., 1998). Several in vivo and in vitro studies also demonstrated the beneficial effects of olive oil phenolics on the oxidative stress markers, reactive oxygen species (ROS), and total plasma antioxidant capacity (Reinish et al., 1998). ROS are formed as natural byproducts of the normal metabolism of oxygen, and play an important role in cell signaling. During a time of environmental stress, ROS levels increase considerably, which cause significant damage to cell structures resulting in oxidative stress. Increased ROS and decreased plasma antioxidant capacity might promote the development of a number of chronic diseases including, atherosclerosis, CVD and certain cancers (Cicerale et al., 2009). Total plasma antioxidant capacity has been shown to increase after ingestion of phenol rich olive oils in both humans and animals (Cicerale et al., 2009).

Cancer development involves a number of processes. In many instances, deregulated cell proliferation and suppressed cell death provide the fundamental basis for tumor progression. A number of in vitro studies have shown that olive oil phenolics have beneficial effects on cellular function (Fabiani et al., 2006; Pettinger., 2007). In human promyelocytic HL60 leukemia cells, an olive oil phenolic extract inhibited cell proliferation in a dose dependent manner; cell growth was completely blocked (Fabiani et al., 2006). In another dose-dependent study, virgin olive oil phenolic compounds were found to inhibit growth and reduce expression of the HER2 oncogene (Cicerale et al., 2009). The antioxidant capacity of olive oil phenolics may partially explain the differences in cancer incidences between Mediterranean populations consuming

significant amounts of virgin olive oil and those populations who do not have as high virgin olive oil consumption.

Phenolic compounds: Effects on platelet function

Blood platelets play a major role in CVD and atherosclerosis. Chronic and recurrent damage to the vascular epithelium result in the development of lesions, which stimulate endothelial molecule expression, platelet activity, and aggregation (Cicerale et al., 2009). Circulating monocytes are attracted to these molecules, adhere to the endothelium and differentiate into macrophages, which scavenge LDL and triglycerides rich lipoproteins. Foam cells develop, forming fatty streaks (Cicerale et al, 2009). In a recent study it was observed that, in healthy persons, a diet rich in olive oil lowered the sensitivity of platelets to collagen-induced aggregation; in a diet enriched with corn oil, the threshold of aggregation was raised (Perez-Jimmenez et al., 2006). Additionally, it was observed that daily administration of 40 ml of virgin olive oil rich in phenolic compounds, after 7 weeks, lowered TXB2 (a metabolite that encourages aggregation) plasma level (Perez-Jimmenez et al., 2006).

Adherence of the platelets to the disrupted endothelium is influenced by the Von Willebrand factor (vWF). Von Willebrand factor is a blood glycoprotein involved in hemostasis; its primary function is to bind to other proteins. It is also very important in platelet adhesion to wound sites. The vWF may be decreased by diets rich in olive oil (Perez-Jimmenez et al., 2006). These findings may partly explain the lowered CVD and

atherosclerosis incidence between the Mediterranean populations compared with other population worldwide.

Dietary Patterns: South versus North

The epidemic rise of cardiovascular disease in many industrialized countries during the middle of the 20th century helped identify risk factors for CVD and the need for preventive measures (Perez-Jimmenez et al., 2005). The 'Seven Countries Study' conducted by Keys et al. was an influential work on the diet-heart disease relationship (Keys et al., 1986). The results of this study introduced the concept of the cardioprotective properties of the Mediterranean diet (Perez-Jimmenez et al., 2005).

Micro- constituents from olive oil are bioavailable in humans and have shown antioxidant properties (Perez-Jimmenez et al., 2005). A recent study has found that 25ml of olive oil per day reduced DNA oxidation. The same authors also found that urinary biomarkers of DNA and RNA oxidation in Northern European countries were higher than those in Southern European countries. These results corresponded to a trend of increase from northern to southern Europe in the urinary excretion of olive oil phenolics and were consistent with the high consumption of olive oil, fruits and vegetables in Mediterranean countries (Machowetz et al., 2007). It is not surprising to observe that in countries where the populations complete a typical Mediterranean diet, such as Spain, Greece and Italy, cancer incidence rates are lower than in northern European countries (Perez-Jimmenez, 2005).

Similarly, per capita dietary fat intake has been shown to be very high in most European countries and in North America while total dietary fat consumption has been shown to be very low in Africa and the Far East (Trichopoulou et al., 1997). However, within the European countries, Spain and Greece revealed a very low consumption of saturated fat when compared to saturated fat intake in the United Kingdom, Poland and Belgium. Consumption of saturated fat intake in Greece and Spain was less than 2.5g/day/person while Poland consumed about 25 g of saturated fat per day per person, those living in the United Kingdom consumed about 10g/day/person (Trichopoulou et al., 1997). On the other hand, consumption of olive oil in Greece and Spain was greater than 40 ml/day/person whereas the olive oil intake in Poland, Belgium, Hungary and the United Kingdom was minimal (Trichopoulou et al., 1997). Therefore, it is not surprising to notice that incidences of the breast, large bowel, and prostate cancers, and incidence of coronary artery disease are higher in countries in which the consumption of saturated fat is high and consumption of olive oil is low (Trichopoulou et al., 1997).

In the Mediterranean region, olive oil has traditionally been consumed in high quantities, contributing 25 to 40% or more of total calories as fat. This high fat intake conflicts with recommendations in Western countries that limit total fat intake to less than 35% of calories (Serra-Majem et al., 2004). Although some studies reported that individuals consuming greater quantities of olive oil had higher total fat intakes than those who consumed less olive oil, the percentage of total calories from saturated fats was lower in those individuals with higher olive oil consumption. Persons with diets higher in dietary fat, primarily olive oil, presented more favorable food profiles that are in line with

Mediterranean diet patterns. In contrast, those with lower total dietary fat intakes and more restricted olive oil consumption had higher intakes of cereals, baked goods, whole fat milk, sausages, candy and soft drinks (Serra-Majem et al., 2004). Also, full fat dairy products and sausages in the group with low olive oil consumption accounted for the greatest intakes of saturated fats (Serra-Majem et al., 2004).

In a recent intervention, the PREMIMED Study (Spain), conducted by Estruch and colleagues, 772 adults subjects at high cardiovascular risk were assigned to a Mediterranean diet (rich in virgin olive oil) or to a low fat diet. After a three month follow up, the Mediterranean style diets promoted positive changes in fasting glucose, systolic blood pressure, and cholesterol LDL/HDL ratio. A reduction in C-reactive protein was observed only in the group consuming an olive oil rich diet (Lairon et al., 2007).

The protective effect of virgin olive oil is most important in the first decades of life, which suggests virgin olive oil should be initiated before puberty, and maintained throughout life (Perez-Jimmenez., 2005). The Seven Countries Study supports this recommendation (Simopoulos et al., 2001). Death rates in the island of Crete have been comparatively very low since 1930 and no other country in the Mediterranean region has had as low a death rate as Crete (Simopoulos et al., 2001). Interestingly enough, deaths from cancer and heart disease are approximately three times greater in the United States than in Crete (Simopoulos et al., 2001). The outcomes of the Seven Countries Study are

appealing because they illustrate the long term health benefits of olive oil and low saturated fat intakes (Simopoulos et al., 2001).

Availability, Consumption, and Nutrition Knowledge of Olive Oil

Studies investigated the psychological, social and cultural influences on food choice between Southern France and Central England found substantial differences in attitudes and beliefs to food and health (Pettinger et al., 2007). The French placed great value on the pleasurable and social aspects of eating, cooking from basic ingredients and having more structured meal times, whereas convenience and snacking seemed to be important features of English food culture (Pettinger et al., 2007). In addition, there are a wider variety of small independent shops in France, making availability and quality of fruits and vegetables (basis of the Mediterranean diet) better in that area, whereas the availability of energy dense snack foods is wider in England (Pettinger et al., 2007).

That said, the diversity and availability of shops found in Southern Europe influence the choice of specific foods available to consumers in the local community. For instance, the proportion of available miscellaneous shops (which include wine cellars, ethnic food shop and specialist olive shop) in Southern France is 7 per 100,000 inhabitants while the proportion of available miscellaneous shops in Central England is 1.9 per 100,000 inhabitants. That influence choice and quality of foods, which constitute the Mediterranean diet (Pettinger et al., 2007). Even though availability of fruit and vegetables is good in both countries, snack foods were more abundant in England. This

clearly impacts on the food environment and could explain the higher prevalence of obesity in England (Pettinger et al., 2007).

Obesity rate is lower in countries that follow a Mediterranean diet (Calza et al., 2008). Obesity is currently considered a common risk factor for many chronic diseases. The widespread increase in its prevalence in recent years, and its association with reduced life expectancy, has made obesity one of the most urgent public health problems. In the United States the prevalence of overweight has increased for adults to 66.3% in 2003-2004 as well as for adolescent to 17.4% in 2003-2004 (Calza et al., 2008). Interestingly enough if we were to compare the US population with the Italian population, which follows a Mediterranean diet, the ratio of overweight people is less significant in the Italian population. Data with a recent analysis on a US national survey found a clear difference in the overall proportion of overweight or obese subjects, especially among women, between the US population (63% of men and 55% of women) and the Italian population (52.7% of men and 35.3% of women), considering only subjects aged 25 or above for comparability (Calza et al., 2008).

It is estimated that one-third of all cancer deaths in the United States could be avoided through appropriate dietary modification. A meta-anlysis of that assessed the effects on antioxidants in reducing cancer risk found that there was a lower risk with increased intake of fruits (including olives) and vegetables (Masella et al., 1999). Consuming the appropriate food may be difficult in some populations. One study showed that poor

access to supermarkets in the United States might have negative implications for dietary quality (Pettinger et al., 2007).

College Student Eating Behavior

Good habits starts early in life and, in the United States, many college students make poor food choices that result in excess calorie intakes, saturated fats and added sugar (Greanet et al., 2009). It is well established in the literature that college students have poor eating habits and that many barriers exist to achieving optimal nutrition (Cousineau et al., 2004). According to results of the 2006 American College Assessment, 4.5% of college students are underweight, 64.1% are a healthful weight, 21.9% are overweight, and 9.5% are obese (Greaney et al., 2009).

Some of the barriers of healthful weight management mentioned in the study were that the food served at the school cafeterias was unhealthful, and the lack of access to healthful food was the main concern (Greaney et al., 2009). Surveys reported that many college students tend to engage in detrimental health practices, such as poor dietary practice. Various researchers have identified the poor eating habits of college students, with one being the overconsumption of saturated fat (Spencer, 2002). Even students indicating a high level of knowledge about CVD risk, their behaviors often did not reflect their knowledge, and 52% of them consumed a diet high in saturated fats (Spencer, 2002). Similarly, another study showed that students tended to eat high fat fast food with a preference for French fries and/or potatoes chips, which are very high in saturated fats (Strong et al., 2008)

Conclusions

The growing popularity of the diet consumed in the Mediterranean Basin (i.e., the Mediterranean diet) is due to the large body of epidemiological studies that demonstrate reduced risk of CVD and certain cancers. It has been suggested that this is largely due to the relatively safe and, potentially protective dietary habits of this area (Visioli et al., 2002). The incidence of fat-related cancers remains low within the Mediterranean population when compared with the American population (Tokudome et al., 2000). Geographical differences in cancer incidence rates indicate a role of environment in the etiology of this disease, with nutrition being one of the most relevant factors involved (Escrish et al., 2007). The Mediterranean Basin consumption of olive oil results in a high intake of oleic acid and polyphenols, which are antioxidants and have anti-carcinogenic properties, and largely surpasses the consumption of olive oil in the United States (see table 1).

However, consumption of olive oil is increasing (see table 2) in non-Mediterranean areas including the United States, due to the growing interest in the Mediterranean diet and its healthful properties (Visioly et al., 2002). The Mediterranean diet is rich in vegetables, whole grain cereals, fruits, wine and olive oil. Olive oil is the main source of fat, and the Mediterranean diet's healthy effects can be attributed to the ratio of unsaturated and saturated fatty acids (in olive oil) and to the antioxidant property of its phenolic compounds (Tripoli et al., 2005).

Although the diet consumed in the Mediterranean Basin is important in reducing the incidence of CVD and cancer in these populations, it is likely to not be the only factor. Genetic, cultural, and lifestyle influences are also important in disease risk reduction. Also, olive oil is not the only component of the diet of the Mediterranean Basin. Other foods commonly consumed have been found to have biological benefits, including fish rich in omega-3 fatty acids, nuts, vegetables, garlic and wine. The evidence indicates, though, that olive oil and its components contribute considerably to the preventative health benefits of the Mediterranean diet (Menendez et al., 2006; Puertollano., 2007).

METHODS

The purpose of the study was to assess the intake and knowledge of olive oil and other lipids in a collegiate population. To achieve this goal, a questionnaire was developed (See appendix A) that assessed college student knowledge and dietary behavior related to fat consumption. The questionnaire and the description protocol were submitted to the Georgia State University IRB for approval (see appendix B). With IRB approval, one faculty member from each academic unit within the College of Health and Human Sciences was contacted. Through these contacts, access to a single course within each academic unit was enabled. At a lecture agreed upon in advance, the investigator introduced the purpose of the study and the requirement to complete the questionnaire if a student volunteered to do so. The questionnaires were distributed to the students by the investigator at the beginning of each of these classes. Classes were selected within the department of health and human sciences because of convenience. The divisions included were Nutrition (NUTR), Respiratory Therapy (RT), Nursing (NURS), Social work (SW), Criminal justice (CJ) and other (OTH). Students who volunteered to complete the questionnaire did so anonymously. Completed questionnaires were collected by the investigator at the end of the class time. It was determined that only subjects that fully completed the questionnaire would be included in the analysis pool.

An SPSS database file was created to include each of the variables in the questionnaire. Data were analyzed using SPSS v15.0 and statistical significance was detected at $P<0.05$. Descriptive statistics were determined for all participants, including frequencies, means, medians and standard deviation grouped students by age, major, and gender to determine differences in both lipid consumption behavior and lipid knowledge. A one way ANOVA was performed to determine if significance existed among groups. Frequency distributions were also analyzed using the Pearson chi square test. Statistical summaries of the responses by subgroup were created as tables and used as the basis for the description of the results.

RESULTS

A total of 96 subjects volunteered for the study. Of these 96 subjects, 40 subject questionnaires were discarded from the study because of a failure to fully respond to the questions. Analysis was completed on 56 student subjects, representing 58% of the initial subject pool. Of these 56 students, 12 subjects (21.4%) were male (M) and 44 subjects (78.6%) were female (F). The average age of the total subject population was 27.3 years (SD=7.6). The oldest subject was 52 years and the youngest was 19 years. There were a total of 13 graduate (GRAD) subjects (23.2%) and 43 undergraduate (UND) subjects (76.8%). Of these 56 subjects, 2 subjects were American Indian (3.6%), 4 subjects were Asian (7.1%), 20 subjects were African American (35.7%), 3 subjects were Hispanic (5.4%), 2 subjects were Hawaiian (3.6%), and 24 subjects were Caucasian (42.9%). The academic majors of the subjects were distributed as follow: 6 from the division of Nutrition (10.7%), 9 from the division of Respiratory Therapy (16.1%), 11 from the school of Nursing (19.6%), 8 from the school of Social Work (14.3%), 13 from the department of Criminal Justice t (23.2%), and 9 from other departments (16.1%).

Lipid Eating Behaviors of the Assessed College Population

To assess the issue of lipid consumption behaviors in a college population, subjects (N=56) responded to a questionnaire containing a series of questions on lipid

consumption frequencies and on lipids in their kitchens. The Likert scale used to determine consumption frequency was: 1= not at all; 2= occasionally; 3= somewhat; 4=often; 5= only oil used and 6= I don't know. The response scale used for lipid in the kitchen had the following options; 1= never; 3= sometimes; and 5= always. What follows is an analysis of means and frequencies of responses by the total subject group and by subgroups (graduate, undergraduate, and academic majors).

Lipid Consumption by Academic Majors

Olive Oil

Taken as a total population, 44.6% indicated they often consumed olive oil, 12.5% indicated that it was the only oil they consumed, and about 14% indicated they never or only occasionally consumed olive oil. Of the nutrition majors (NUTR), 66% indicated that olive oil was often consumed, and 33.3% indicated it was the only oil used. The mean response for NUTR was 4.33 (SD=0.41) on the Likert scale. Respiratory Therapy (RT) indicated that they often consumed olive oil (55.6%), or it was the only oil consumed (22%). The mean response for RT was 3.78 (SD=1.20) on the Likert scale. Nursing majors (NURS) indicated that olive oil was often consumed (54%) or that it was the only oil used (9.1%). The mean response for NURS majors was 4.18 (SD=1.16) on the Likert scale. Of the social work majors (SW) who responded, 62.5% indicated that they often consumed olive oil while 25% indicated that they used olive oil only occasionally. The mean Likert scale response for SW majors was 3.38 (SD=3.00). A smaller proportion of criminal justice majors (CJ) and other majors (OTH) indicated that they often consumed olive oil (33.8% and 11.1% respectively). CJ majors responded that

43.6% only occasionally used olive oil and 77% or OTH only occasionally used olive oil. The mean response for the CJ majors was 3.77 (SD=1.09) on the Likert scale, while the mean response for the category OTH was 3.11 (SD=1.26). The differences in olive oil consumption between academic majors were not statistically significantly. A small proportion (7.1%) of total reported not knowing the frequency with which they consumed olive oil. (See table 3 for mean responses to consumption questions).

Butter

The modal response for butter consumption in TOTAL was occasionally consumed by 32.1%, and somewhat often or often by 23.2% and 26.8% respectively. A smaller proportion of TOTAL (5.4%) did not know how often they consumed butter. NUTR reported occasionally consuming butter (50%), while it was never consumed by 16.7%, somewhat consumed by 16.7% and often consumed by 16.7%. The mean response for NUTR was 2.33 (SD=1.03) on the Likert scale. RT occasionally ate butter at a rate of 44.4%, and 22.2% of RT reported often consuming butter or somewhat consuming butter. The mean Likert scale response for RT was 3.00 (SD=1.11). The modal response for butter consumption in the NURS was often consumed by 36.4%. The mean Likert scale response for the NURS majors was 3.36 (SD=1.74). SW students had a bimodal response to butter consumption with 37.5% occasionally consuming butter and 37.5% often consuming butter. SW had a mean response of 3.00 (SD=.92) on the Likert scale. CJ also had a bimodal response to butter consumption with 30.8% indicating somewhat consuming butter and often consuming butter. The mean response for CJ majors was 3.08 (SD=1.38). Undefined major (OTH) reported eating butter occasionally by 44.4%. The

mean response for OTH was 2.89 (SD=1.05). There was no statistical difference between academic majors in the consumption of butter.

Canola Oil

The total group indicated often (25%) as the modal response for canola oil. Never used, occasionally used and somewhat used had almost the same response at 20% each. Of the total responders, 10.7% did not know how often they consumed canola oil. Of the academic majors, NUTR reported often (50%) for canola oil consumption. The next nearest major for often consumption of canola oil was SW at 37.5%. RT had a modal response of 66% for never consuming canola oil. The distribution for canola oil consumption was otherwise evenly distributed for all other responses. The mean responses were 3.00 (SD=1.26) for NUTR, 1.89 (SD=1.53) for RT, 3.73 (SD=1.61) for NURS, 2.75 (SD= 1.28) for SW, 3.00 (SD=1.22) for CJ, and 3.44 (SD=1.81) for OTH. There was a statistically significant difference in consumption of canola oil between academic majors (Pearson chi square P=.041).

Peanut Oil

Of TOTAL, 41.1% indicated they never consumed peanut oil, 1.8% indicated that it was the only oil they consumed, about 27% indicated they occasionally consumed peanut oil and 19.6% of the total responders reported not knowing the frequency with which they consumed peanut oil. NUTR indicated that peanut oil was never consumed (66.7%), or occasionally consumed (33.3%). The mean response for the NUTR was 1.33 (SD=.51) on the Likert scale. RT indicated that they never consumed peanut oil (66.7%) or it was used

occasionally (22.2%). The mean response for the RT was 1.78 (SD=1.64). Similarly, NURS indicated that peanut oil was occasionally consumed (27.3%) and that it was never used (36.4%). The mean response for the NURS was 2.82 (SD=2.13). Of the SW who responded, 50% indicated that they occasionally consumed peanut oil while 37.5% indicated that they never used peanut oil. The mean response for the SW was 1.75 (SD=.70). Of CJ, 23.1% indicated that they occasionally consumed peanut oil, 15.4% responded that they never used peanut oil, and 15.4% responded that they somewhat used peanut oil.. The mean response for the CJ majors was 3.69 (SD=2.05). OTH responded never using peanut oil (44.4%) and occasionally using peanut oil (11.1%). The mean response for OTH was 2.89 (SD=2.20). The difference in peanut oil consumption between academic majors was not statistically significant.

Corn Oil

Of TOTA, 44.6% indicated they never consumed corn oil, 5.4% indicated that it was the only oil they consumed, and about 28% indicated they somewhat or occasionally consumed corn oil, and 21.4% of TOTAL reported not knowing the frequency with which they corn oil. NUTR indicated that corn oil was occasionally consumed (50%), or never used (33.3%). The mean response for the NUTR was 2.33 (SD=1.86). RT indicated that they never consumed corn oil (88.9%). The mean response for the RT was 1.56 (SD=1.66). NURS indicated that corn oil was occasionally consumed (36.4%) and that it was never used (18.2%). The mean response for the NURS was 3.18 (SD=1.99). Of the SW who responded, 50% indicated that they never consumed corn oil while 37.5% indicated that they occasionally used corn oil. The mean response for the SW majors was

1.75 (SD=1.03). Of the CJ, 30.8% indicated that they never consumed corn oil, while 23.1% responded that they occasionally used corn oil. The mean response for the CJ was 3.31 (SD=2.28). OTH responded often using corn oil (11.1%), never using corn oil (55.6%), and occasionally using corn oil (11.1%). The mean response for the category OTH was 2.56 (SD=2.18). The difference in corn oil consumption between academic majors was not statistically significant.

Margarine

Of TOTAL, 44.6% indicated they never consumed margarine, 37.5% indicated that it was somewhat or occasionally consumed; about 12.5% indicated they often consumed margarine, and 5.4% of TOTAL reported not knowing the frequency with which they consume margarine. NUTR indicated that margarine was occasionally consumed (33.3%), or never used (66.7%). The mean response for the NUTR was 1.33 (SD=.51). RT indicated that they never consumed margarine (66.7%) or it was used occasionally (22.2%). 11.1% responded that they often consumed margarine. The mean response for the RT was 1.56 (SD=1.01). NURS indicated that margarine was occasionally consumed (18.2%), often consumed (9.1%), never consumed (45.5%), and that it was often consumed (18.2%). The mean response for the NURS was 2.55 (SD=1.96). Of the SW who responded, 87.5% indicated that they occasionally consumed margarine while 12.5% indicated that they never used margarine. The mean response for the SW was 1.88 (SD=.35). 23.1% of CJ indicated that they often consumed margarine, while 46.2% responded that they never used margarine. The mean response for the CJ was 2.54 (SD=1.66). OTH responded occasionally using margarine (44.4%) and never using

margarine (33.3%). The mean response for the category OTH was 2.11 (SD=1.16). The difference in margarine consumption between academic majors was not statistically significant.

Sunflower Oil

Of TOTAL, 55.4% indicated they never consumed sunflower oil, 1.8% indicated that it was the only oil they consumed, about 22% indicated they somewhat or occasionally consumed sunflower oil, and 21.4% of TOTAL reported not knowing the frequency with which they consumed sunflower oil. NUTR indicated that sunflower oil was never consumed (66.7%), or somewhat consumed (16.7%). The mean response for the NUTR was 2.17 (SD=2.04). RT indicated that they never consumed sunflower oil (88.9%). The mean response for the RT was 1.56 (SD=1.66). NURS indicated that sunflower oil was occasionally consumed (36.4%) and that it was never consumed (36.4%). The mean response for the NURS was 2.73 (SD=2.14). Of the SW who responded, 25% indicated that they occasionally consumed sunflower oil while 62.5% indicated that they never used sunflower oil. The mean response for the SW was 1.63 (SD=1.06). 38.5% of CJ indicated that they never consumed sunflower oil, while 23.1% responded that they occasionally used sunflower oil. The mean response for the CJ was 3.15 (SD=2.12). OTH responded never using sunflower oil (55.6%) and occasionally using sunflower oil (11.1%). The mean response for OTH was 2.44 (SD=2.12). The difference in sunflower oil consumption between academic majors was not statistically significant.

Soybean Oil

Of TOTAL, 55.4% indicated they never consumed soybean oil, 5.4% indicated that it was the only oil they consumed, about 14.3% indicated they occasionally consumed soybean oil, and16.1% of TOTAL reported not knowing the frequency with which they consumed soybean oil. NUTR indicated that soybean oil was occasionally consumed (16.7%), never consumed (50%), and often consumed (16.7%). The mean response for the NUTR was 2.00 (SD=1.26). RT indicated that they never used soybean oil (77.8%) or it was used occasionally (11.1%). The mean response for the RT was 1.67 (SD=1.65). NURS indicated that soybean oil was occasionally consumed (36.4%) and that it was never consumed (18.2%). The mean response for the NURS was 2.91 (SD=1.75). Of the SW who responded, 62.5% indicated that they never consumed soybean oil while 25% indicated that they often or somewhat consumed soybean oil. The mean response for the SW was 1.75 (SD=1.16). 53.8% of CJ indicated that they never used soybean oil, while 7.7% responded that they occasionally used soybean oil. The mean response for the CJ was 2.77 (SD=2.31). Of OTH, 77.8% responded that they never used soybean oil. The mean response for OTH was 2.11 (SD=2.20). The difference in soybean oil consumption between academic majors was not statistically significant.

Lipid Consumption: Graduate versus Undergraduate

Olive oil

Of the total graduate population (GRAD), 46.2% responded that they often used olive oil, 15.4 % responded that they only consumed olive oil while 7.7% indicated that they never used olive oil. Of the undergraduate population (UND), 44.2% responded that they often

used olive oil, 11.6% responded that they used only olive oil, and 11.6% pointed out that they occasionally used olive oil. The difference in olive oil consumption between graduates and undergraduates was not statistically significant.

Butter

Of GRAD, 46.2% responded that they occasionally consumed butter, 30.8 % responded that they somewhat consumed butter, 7.7% indicated that they never consumed butter, and 15.4% reported that they often consumed butter. Of UND, 30.2% responded that they often used butter, 4.7% responded that they only used butter, 27.9% pointed out that they occasionally used butter and 9.3% of the responders reported that they never used butter. The difference in butter consumption between graduates and undergraduates was not statistically significant.

Canola Oil

Of GRAD, 46.2% responded that they often consumed canola oil, 30.8 % responded that they never consumed canola oil while 7.7% indicated that they occasionally consumed canola oil. Of UND, 18.6% responded that they often used canola oil, 25.6% responded that they occasionally used canola oil, 16.3% pointed out that they never used canola oil, and 2.3% of the responders reported that they always used canola oil. The difference in canola oil consumption between graduates and undergraduates was not statistically significantly different.

Peanut Oil

Of GRAD, 61.5% responded that they never consumed peanut oil, while 38.5% responded occasionally or somewhat. Of UND, 34.9% indicated that they never consumed peanut oil, 25.6% indicated occasionally, and 4.6% indicated often. The difference in peanut oil consumption between graduates and undergraduates was not statistically significant.

Corn Oil

Of GRAD, 38.5% responded that they occasionally consumed corn oil, while 53.8% indicated that they never consumed corn oil. Of UND, 20.9% responded that they occasionally used corn oil, 4.7% responded that they somewhat used corn oil, and 41.9% pointed out that they never used corn oil. The difference in corn oil consumption between graduates and undergraduates was not statistically significant.

Margarine

Of GRAD, 46.2% responded that they occasionally consumed margarine while 53.8% responded that they never used margarine. Of UND, 16.3% responded that they often used margarine, 25.6% responded that they occasionally used margarine, and 41.9% pointed out that they never used margarine. The difference in margarine consumption between graduates and undergraduates was not statistically significant.

Sunflower Oil

Of GRAD, 7.7% responded that they occasionally consumed sunflower oil, while 69.2% indicated that they never consumed sunflower oil, and15.4 % responded that they somewhat consumed sunflower oil. Of UND, 20.9% responded that they occasionally used sunflower oil, 2.3% responded that they somewhat used sunflower oil, and 51.2% pointed out that they never used sunflower oil. The difference in sunflower oil consumption between graduates and undergraduates was not statistically significant.

Lipids Found in the Kitchen: Differences by Academic Majors

Olive Oil

Of TOTAL, 64% indicated they always had olive oil in their kitchen. 25% indicated that they sometime had olive oil in their kitchen, and about 10% indicated they often had olive oil in their kitchen. NUTR reported that olive oil was always in their kitchen (100%). The mean response for the NUTR was 5.00 (SD=.00). RT indicated that they always had olive oil in their kitchen (55.6%) or that it was sometime found in their kitchen (11%). The mean response for the RT was 4.56 (SD=1.01). NURS indicated that olive oil was always found in their kitchen (63.6%) or that it was sometime found in their kitchen (27.3%). The mean response for the NURS was 4.36 (SD=.92). Of the SW who responded, 75% indicated that they always had olive oil in their kitchen while 12.5% indicated that they sometime had olive oil in their kitchen. The mean response for the SW was 4.50 (SD=1.06). CJ and OTH indicated that they always had olive oil in their kitchen (46.2% and 44.4% respectively). CJ responded that 15.4% sometime had olive oil in their kitchen while 33.3% of OTH reported that they sometime had olive oil in their kitchen.

The mean response for the CJ was 3.85 (SD=1.21), and the mean response for OTH was 4.11 (SD=0.92). The difference in kitchen olive oil between academic majors was not statistically significant. (See table 4 for mean responses of purchase of common foods)

Margarine

Of TOTAL, 19.6% indicated they always had margarine in their kitchen. 32.9% indicated that they sometime had margarine in their kitchen, and about 37% indicated they never had margarine in their kitchen. NUTR indicated that margarine was never in their kitchen (66.7%), sometime in their kitchen (16.7%), and always in their kitchen (16.7%). The mean response for the NUTR was 1.67 (SD=1.36). RT indicated that they never had margarine in their kitchen (55.6%), sometime in their kitchen (22.2%), and always in their kitchen (22.2%). The mean response for the RT was 2.33 (SD=1.73). NURS indicated that margarine was never found in their kitchen (27.3%), and sometime found in their kitchen (72.8%). The mean response for the NURS was 2.18 (SD=.87). Of the SW who responded, 50% indicated that they never had margarine in their kitchen while 37.5% indicated that they sometime had margarine in their kitchen. 12.5% reported that they always had margarine in their kitchen. The mean response for the SW was 1.88 (SD=1.12). CJ and OTH indicated that they never had margarine in their kitchen (23.1% and 22.2% respectively). CJ responded that they sometime had margarine in their kitchen (38.5%), and always (38.5%). Of the OTH, 55.6% reported that they sometime had margarine in their kitchen, while 22.2% reported that they always had margarine in their kitchen. The mean response for the CJ was 3.08 (SD=1.49), and the mean response for

OTH was 2.67 (SD=1.50). The difference in kitchen margarine between academic majors was not statistically significant.

Butter

Of TOTAL, 55.4% indicated they always had butter in their kitchen. 25% indicated that they sometime had butter in their kitchen, and about 14.3% indicated they never had butter in their kitchen. NUTR indicated that butter was always in their kitchen (33.3%), sometime in their kitchen (50%), and never in their kitchen (16.7%). The mean response for the NUTR was 3.33 (SD=1.50). RT indicated that they always had butter in their kitchen (55.5%), sometime found in their kitchen (33.3%), and never found in their kitchen (11.1%). The mean response for the RT was 3.67 (SD=1.50). NURS indicated that butter was always found in their kitchen (45.5%) or that it was sometime found in their kitchen (27.3%). 27.3% responded that they never had butter in their kitchen. The mean response for the NURS was 3.36 (SD=1.74). Of the SW who responded, 62.5% indicated that they always had butter in their kitchen while 37.5% indicated that they sometime had butter in their kitchen. The mean response for the SW was 4.13 (SD=1.24). CJ and OTH indicated that they always had butter in their kitchen (30.8% and 22.2% respectively). CJ responded that 15.4% sometime had butter in their kitchen, while 33.3% of OTH reported that they sometime had butter in their kitchen. Only 23.1% of the CJ pointed out that they never had butter in their kitchen. The mean response for the CJ was 3.38 (SD=1.60), and the mean response for OTH was 3.89 (SD=.78). The difference in kitchen butter between academic majors was not statistically significant.

Canola Oil

Of TOTAL, 36.5% indicated they always had canola oil in their kitchen. 37.5% indicated that they sometime had canola oil in their kitchen, and 25% indicated they never had canola oil in their kitchen. NUTR indicated that canola oil was always in their kitchen (66.7%), and sometime in their kitchen (33.3%). The mean response for the NUTR was 4.17 (SD=.98). RT indicated that they always had canola oil in their kitchen (22.2%), sometime found in their kitchen (33.3%), and never found in their kitchen (44.4%). The mean response for the RT was 2.33 (SD=1.65). NURS indicated that canola oil was always found in their kitchen (18.2%) or that it was sometime found in their kitchen (54.5%), and 18.2% responded that they never had canola oil in their kitchen. The mean response for the NURS was 3.36 (SD=1.20). Of the SW who responded, 62.5% indicated that they always had canola oil in their kitchen while 12.5% indicated that they sometime had canola oil in their kitchen. 25% reported that they never had canola oil in their kitchen. The mean response for the SW was 3.38 (SD=1.76). CJ and OTH indicated that they always had canola oil in their kitchen (30.8% and 44.4% respectively). CJ responded that 46.2% sometime had canola oil in their kitchen, while 22.2% of OTH reported that they sometime had butter in their kitchen. Only 23.1% of the CJ pointed out that they never had canola oil in their kitchen, while 33.3% of OTH reported that they never had canola oil in their kitchen. The mean response for the CJ was 2.92 (SD=1.60), and the mean response for the category OTH was 3.00 (SD=1.80). The difference in kitchen canola oil between academic majors was not statistically significant different.

Lipids Found in the Kitchen: Graduates versus Undergraduates

Olive Oil

Of GRAD, 76.9% responded that they always had olive oil in their kitchen, and 23 % responded that they sometime had olive oil in their kitchen. Of UND, 74.4% responded that they always had olive oil in their kitchen while 25.6% responded that they sometime had olive oil in their kitchen. The mean response for GRAD was 4.31 (SD=1.18). The mean response for UND was 4.33 (SD=.96). The difference in the kitchen olive oil in between GRAD and UND was not statistically significant.

Margarine

Of GRAD, 23.1% responded that they always had margarine in their kitchen, 53.8% reported that they never had margarine in their kitchen, and 23.1 % responded that they sometime had margarine in their kitchen. Of UND, 18.7% responded that they always had margarine in their kitchen, 48.8% responded that they sometime had margarine in their kitchen, and 32.6% reported that they never had margarine in their kitchen. The mean response for GRAD was 2.15 (SD=1.46). The mean response for UND was 2.47 (SD=1.36). The difference in kitchen margarine between GRAD and UND was not statistically significant.

Butter

Of GRAD, 46.2% responded that they always had butter in their kitchen, 7.7% reported that they never had butter in their kitchen, and 46.2 % responded that they sometime had butter in their kitchen. Of UND, 58.1% responded that they always had butter in their kitchen, 30.4% responded that they sometime had butter in their kitchen, and 16.3% reported that they never had butter in their kitchen. The mean response for GRAD was 3.77 (SD=1.30). The mean response for UND was 3.56 (SD=1.46). The difference in kitchen butter between GRAD and UND was not statistically significant.

Canola Oil

Of GRAD, 61.6% responded that they always had canola oil in their kitchen, 7.7% reported that they never had canola oil in their kitchen, and 30.8 % responded that they sometime had canola oil in their kitchen. Of UND, 30.3% responded that they always had canola oil in their kitchen, 39.5% responded that they sometime had canola oil in their kitchen and 32.2% reported that they never had canola oil in their kitchen. The mean response for GRAD was 3.85 (SD=1.34). The mean response for UND was 2.65 (SD=1.55). The difference in the kitchen canola oil between GRAD and UND was not statistically significant.

Conclusions

It was hypothesized that the eating behavior of the assessed college population will demonstrate a relative overconsumption of unhealthy lipids compared to an

underconsumption of olive oil. To assess this hypothesis, variables asking the frequency of consumption and types of lipids in the kitchen were responded to. There were no statistical significant differences between the ratios of consumption of good to bad lipids and there were no statistical differences in good to bad lipids in the responders' kitchens. Therefore, the findings of this study were not able to disprove the null hypothesis. However, sub-groups within the tested population (graduate students, undergraduate students, and academic majors) did have several statistically significant differences in the consumption of specific lipids.

Lipids Knowledge of the Assessed College Population

To assess this issue, subjects (N=56) responded to a questionnaire containing a series of questions on lipid knowledge. The possible answers, either correct or incorrect for each of the lipid were; 1= saturated fat, 2= MUFA, 3= PUFA, 4= trans- fats, 5= polyphenols, and 6= I don't know. What follows is an analysis of percentage of responses by total group and by subgroup (graduate, undergraduate, and academic majors).

Lipid Knowledge by Academic Majors

Olive Oil

Of TOTAL (N=56), 55.4% indicated they did not know what olive oil contained, while 33.9% responded incorrectly on the contents of olive oil. Only a small proportion of the total population (10.7%) responded correctly by stating that olive oil contained polyphenols and MUFA. Of NUTR (n=6), 100% responded correctly. Of RT (n=9), 33.3% indicated that olive oil contained either PUFA or saturated fat (incorrect

responses), while 66.7% responded they did not know the contents of olive oil. Of NURS (n=11), 63.6% majors indicated correctly that olive oil contained MUFA and polyphenols while 27.3% did not know the contents. Of the SW (n=8), 75% did not know the answers on olive oil, and 25% responded correctly (MUFA and polyphenols). Of CJ (n=13), 61.5% indicated that they did not know what olive oil contained, 22.1% responded incorrectly, and 15.5% responded MUFA. Of OTH (n=9), 88.9% responded that they did not know what olive oil contained while 11.1% responded incorrectly (PUFA). There was a statistically significant difference in olive oil knowledge between academic majors (Pearson chi square P=0.001). (See table 5 for mean responses of fats and oils knowledge).

Butter

Of TOTAL, 55.4% indicated correctly that butter contained saturated fat, while 26.8% responded that they did not know the answers. Of the NUTR, 83.3% responded correctly. Of the RT, 66.7% indicated that butter contained saturated fat while 22.2% did not know the answers. Of the NURS, 63.6% responded correctly while 18.2% did not know what butter contained. Of the SW who responded, 50% responded correctly and 25% did not know the answers. Of CJ, 46.2% indicated that they did not know what butter contained, while 38.5% responded correctly. Of OTH, 33.3 % reported that they did not know the contents and 44.4% responded correctly. The difference in butter knowledge between academic majors was not statistically significant.

Canola Oil

Taken as a total population, 57.1% indicated they did not know what canola oil contained, while 30.4% responded incorrectly on the canola oil contents. Only a small proportion of TOTAL (12.5%) responded correctly by stating that canola oil contained MUFA. Only 33.3% of the NUTR responded correctly while 66.6% responded incorrectly. Of the RT, 11.1% indicated that canola oil contained MUFA, 44.4% responded they did not know the contents of canola oil, and 44.4% responded incorrectly. OF the NURS, 27.3% indicated correctly that canola oil contained MUFA, 36.4% did not know the answers, and 36.4% responded incorrectly. Of the SW, 87.5% either did not know the answers or responded incorrectly, and 12.5% responded correctly. Of CJ, 69.2% indicated that they did not know what canola oil contained, 7.7% responded incorrectly, and 23.1% responded correctly. Of OTH, 100 % reported not knowing the answers. There was a statistically significant difference in canola oil knowledge between academic majors (Pearson chi square P=.021).

Peanut Oil

Of TOTAL, 62.5% indicated they did not know what peanut oil contained, 18.2% responded incorrectly, and 10.7% responded correctly by stating that peanut oil contained MUFA. Of NUTR, 16.7% responded correctly, 50.1% responded incorrectly, and 33.3% indicated not knowing the answers. Of RT, 11.1% indicated that peanut oil contained MUFA, 33.3% responded incorrectly, and 55.6 % responded not knowing the answers. About 36 % of the NURS responded correctly, 18.2% did not know the answers while

45.5% mentioned not knowing the answers on peanut oil. Of SW who responded, 87.5% did not know the answers, and 12.5% responded incorrectly. OF CJ, 61.5% indicated that they did not know what peanut oil contained, 23.1% responded incorrectly, and 15.4% responded correctly. Of OTH, 88.9 % responded that they did not know what peanut oil contained while 11.1% responded incorrectly. The difference in peanut oil knowledge between academic majors was not statistically significant.

Sunflower Oil

Of TOTAL, 67.9% indicated they did not know what sunflower oil contained, while 21.5% responded incorrectly on the sunflower oil contents. Only a small proportion (10.7%) responded correctly by stating that sunflower oil contained PUFA. Of NUTR, 33.3% responded correctly, 50% responded incorrectly and 16.7% reported not knowing the answers. Of RT, 11.1% indicated that sunflower oil contained PUFA, 77.8% responded that they did not know, while 11.1% responded incorrectly. Of NURS, 18.2% indicated correctly that sunflower oil contained PUFA, 36.4% responded incorrectly, and 45.5% reported not knowing the answers. Of SW who responded, 87.5% did not know the answers on sunflower oil, and 12.5% responded incorrectly. Of CJ, 69.2% indicated that they did not know the contents, 23.1% responded incorrectly, and 7.7% responded PUFA. Of OTH, 100 % reported not knowing the answers. The difference in sunflower oil knowledge between academic majors was not statistically significant.

Soybean Oil

Of TOTAL, 64.3% indicated they did not know what soybean oil contained, while 25.1% responded incorrectly. Only a small proportion (5.4%) responded correctly by stating that soybean oil contained PUFA. Of NUTR, 33.3% responded correctly, 50% responded incorrectly and 16.7% reported not knowing the answers. Of RT, 11.1% indicated that soybean oil contained PUFA, 77.7% responded that they did not know, and 11.1% responded incorrectly. Of NURS, 54.6% responded incorrectly, and 45.5% reported not knowing the answers. Of SW who responded, 75% did not know the answers, and 25% responded incorrectly. Of CJ, 69.2% indicated that they did not know the answers, and 30.8% responded incorrectly. Of OTH, 88.9% reported not knowing the answers while 11.1% responded incorrectly. The difference in soybean oil knowledge between academic majors was not statistically significant.

Margarine

Of TOTAL, 41.1% indicated they did not know what margarine contained, while 51.8% responded correctly by indicating that margarine contains saturated fats and trans fatty acids. Of NUTR, 100% responded correctly. Of RT, 66.7% responded correctly while 33.3% reported not knowing the answers. Of NURS, 72.8% responded correctly, and 27.3% did not know the answers. Of SW, 37.5% did not know the answers, and 50% responded correctly. Of CJ, 61.5% indicated that they did not know the answers, and 15.4% responded incorrectly. Of OTH, 66.7% reported not knowing the answers while 33.3% responded correctly. The difference in margarine knowledge between academic majors was not statistically significant.

Corn Oil

Of TOTAL, 67.9% indicated they did not know what corn oil contained, and only a small proportion (7.1%) responded correctly by stating that corn oil contained PUFA. Of NUTR, 50% responded correctly, and 16.7% reported not knowing the answers. Of RT, 11.1% indicated that corn oil contained PUFA while 77.8% responded that they did not know. Of NURS, 45.5% responded incorrectly, and 54.5% reported not knowing the answers. Of SW who responded, 87.5% did not know the answers, and 12.5% responded incorrectly. Of CJ, 69.2% indicated that they did not know the answers, while 30.8% responded incorrectly. Of OTH, 88.9% reported not knowing the contents of corn oil, and 11.1% responded incorrectly. There was a statistically significant difference in corn oil knowledge between academic majors (Pearson Chi -Square P=.021)

Lipid Knowledge: Graduate versus Undergraduate Students

Olive Oil

Of GRAD, 15.4% indicated that they did not know the contents of olive oil, 23.1 % responded incorrectly, and 61.6% responded correctly (MUFA and polyphenols). Of UND, 67.4% responded that they did not know the answers, 11.6% responded incorrectly, and 20.9% responded correctly. The differences in olive oil knowledge between GRAD and UND was statistically significant (Pearson Chi-Square, P=0.001).

Canola Oil

Of GRAD, 23.1% indicated that they did not know what canola oil contained, 53.9 % responded incorrectly, and 23.1% responded correctly (PUFA). Of UND, 67.4% responded that they did not know the answers, 23.2% responded incorrectly, and 11.6% indicated PUFA. The difference in canola oil knowledge between GRAD and UND was not statistically significant.

Butter

Of GRAD, 7.7% indicated that they did not know what butter contained, while 76.9% responded correctly (saturated fat). Of UND, 32.6% responded that they did not know the answers, and 48.8% indicated the correct answer. The difference in butter knowledge between GRAD and UND was not statistically significantly different.

Peanut Oil

Of GRAD, 38.5% indicated that they did not know what peanut oil contained, while only 7.7% responded correctly (MUFA). Of UND, 69.8% responded that they did not know the answers on peanut oil contents, and 16.3% responded correctly. The difference in peanut oil knowledge between GRAD and UND was statistically significant (Pearson Chi-Square, P=0.028).

Sunflower Oil

Of GRAD, 38.5% indicated that they did not know the content of sunflower oil, while 23.1% responded correctly (PUFA). Of UND, 76.7% responded that they did not know

the answers, and only a small proportion (7%) responded correctly. The difference in sunflower oil knowledge between GRAD and UND was statistically significant (Pearson Chi-Square, P=0.017).

Corn Oil

Of GRAD, 30.8% indicated that they did not know the content of corn oil, while the same proportion of responders (30.8%) answered correctly (PUFA). Of UND, 79.1% responded that they did not know the answers, and 0% responded correctly. The differences in corn oil knowledge between GRAD and UND was statistically significant (Pearson Chi-Square, P=0.001).

Soybean Oil

Of GRAD, 23.1% indicated that they did not know the contents of soybean oil, and 23.1% responded correctly (PUFA). Of UND, 76.7% responded that they did not know the answers while 0% of the UND responded correctly. The difference in soybean oil knowledge between GRAD and UND was statistically significant (Pearson Chi-Square, P=0.000).

Margarine

Of GRAD, 15.4% indicated that they did not know the contents of margarine, while 76.9% answered correctly (saturated fat and trans fatty acids). Of UND, 48.8% responded that they did not know the answers, and 44.2% responded correctly. The difference in margarine knowledge between GRAD and UND was not statistically significant.

Conclusions

A majority (55.5%) of the subjects did not know what olive oil contains, and 33.9% who thought they knew the contents of olive oil responded incorrectly. A majority of subjects (55.4%) correctly indicated that butter contained saturated fats, while 26.8% indicated they did not know. A majority of subjects (57.1%) indicated they did not know the content of canola oil, and 31.4% who thought they knew responded incorrectly. A minority of subjects (12.5%) responded correctly that canola oil contains MUFA. Of TOTAL, a majority (62.5%) did not know the content of peanut oil, and an additional 18.2% responded incorrectly on peanut oil content.

Of TOTAL, a majority (67.9%) indicated no knowledge of sunflower oil, while 21.5% responded incorrectly on the contents of sunflower oil. Of TOTAL, 64.3% indicated no knowledge of soybean oil contents, 25.1 % responded incorrectly on soybean oil contents. Of TOTAL, 41.1% did not know what margarine contain, when 51.8% responded correctly that margarine contains saturated fats and trans fats. Of total, a majority (67.9%) did not know what corn oil contained and only small proportion (7.1%) responded correctly. In only one case (butter) did the majority of students demonstrate correct knowledge of lipid contents. By contrast, a majority of students demonstrated a lack of knowledge for olive oil, canola oil, peanut oil, sunflower oil, soybean oil, corn oil, and margarine. Based on this result, the study is able to reject the null hypothesis. The tested population does indeed demonstrate a general lack of knowledge of the content of the commonly consumed lipids with butter as the exception. There are however clear

differences in subject subgroups in their knowledge of commonly consumed lipid contents, with, most notably, 100% of nutrition students responded correctly to the content of olive oil.

DISCUSSION

Fruit, vegetable and fat intakes do not meet the recommended guidelines in the United States (Nelson et al., 2009). According to a study on children's eating behavior, parents were concerned with children eating too much junk food and fat (French fries, bread, sweets, desserts and salty snacks) and not enough fruits and vegetables (Nelson et al., 2009). Most of these junk food items contain a high level of saturated fatty acids and hydrogenated oils. In a similar way, Georgia State University student subjects possessed in their kitchen salty snacks, such as potato chips, butter, and large amount of candies (see table 4). These results agree with the previous study performed by Nelson et al. (2009) on eating behavior among young adults that assessed food availability in college-student dormitory rooms. A different study found that 70% of the students had each the following types of items: salty snacks, main dishes, desserts or candy, and sugar-sweetened beverages. Fewer students had fruits, vegetables and healthy lipids (i.e. olive oil), which are the main component of the Mediterranean diet (Cullen et al., 2000).

Availability of fruits, vegetables and lipids appeared adequate among Georgia State University student subjects. However, the frequency of fruits and vegetables purchased by graduate students (X=4.77, SD=.59) was better than undergraduate students (X=4.49, SD=.85), (see table 5). Although unexpected, undergraduate students and graduate students had similar scores on olive oil in the kitchen. While the scores were almost

identical, it was expected that graduate students would have scored higher in olive oil because of their better fruit/vegetable consumption.

The mean score of butter consumed by graduate students (X= 2.54, SD= .87) was better (i.e. lower) than undergraduate students (X=3.14, SD=1.33), (See Table 3). The mean score for the margarine consumption was 1.46 (SD=.51) for graduate students and the mean score for undergraduate students was 2.28 (SD=1.50). These scores were not statistically significant, but it showed a general trend with graduate students having a tendency to consume healthier lipids.

Past studies have established a correlation between education level and healthy eating behavior. Indeed, a study explored the relationship between CVD and years of schooling in different populations (Perova et al., 2001). This study found an inverse association between years of schooling and CVD, as years of schooling is a major determinant of socioeconomic status and dyslipidaemia is a major CVD determinant. There was an inverse relationship between plasma lipids levels and years of schooling within each population. Years of schooling were a marker of social status and control of resources, and it related to knowledge and the ability to translate that knowledge to health behavior relevant to lipid levels (Perova et al., 2001).

A study examined the college students' healthful weight management and concluded that the level of college education might be an enabler in choosing a healthy eating pattern (Greaney et al., 2009). However, these past studies were inconsistent with the present

study. Except for nutrition students, student subjects demonstrated a lack of knowledge of lipids and an inadequate consumption of healthy lipids. Nutrition student subjects did better at choosing and eating healthy lipids (olive oil consumption, X=5.00, SD=.00) and consuming fruits and vegetables (X=4.83, SD=.40). Nutrition students limited their consumption of bad lipids, such as margarine (X=1.67, SD=1.21), and butter (X=3.33, SD=1.50) compared to in the category 'other department'. These student subjects had a mean score for margarine of 2.67 (SD=1.50), and a mean score for butter of 3.89 (SD=.78). Although these scores were not statically significantly different, nutrition students had the best mean scores to most questions on fat and oil knowledge. In general, there appeared to be an awareness concerning the content of various lipids, which may be explained by the education focus of dietetic students.

Despite past studies (Greaney et al., 2009; Perova., 2001) showing a relationship between level of education and healthy eating habits, the incidence of cancer (breast, colorectal and prostate) in the Mediterranean countries is lower than in the United States (Trichopoulou et al., 2000). These forms of cancer have been linked to dietary factors, including low consumption of vegetables and fruit, and high consumption of lipid (Trichopoulou et al., 2000). It was estimated that up to 25% of the incidence of colorectal cancer, 15% of the incidence of breast cancer, and 10% of the incidence of prostate cancer could be prevented if the populations of highly developed Western countries shifted to the traditional healthy Mediterranean diet (Trichopoulou et al., 2000). In the United States, a large segment of the population is conscious of the many benefits of a healthy diet such as the Mediterranean one, however, cancer incidence rates and CVD are

rampant (Trichopoulou et al., 2000). Therefore, nutrition education and marketing strategies should communicate the Mediterranean diet more aggressively. Studies among the elderly in Spain and Greece have shown that the overall Mediterranean dietary pattern also positively influences (Leonhauser et al., 2004). One essential question should be addressed at this time: Is the Mediterranean diet transferable to populations living far from the Mediterranean area?

CONCLUSIONS

The Mediterranean diet could be described as the dietary pattern found in the olive oil growing areas of the Mediterranean Basin. Beyond olives and olive oil, it is also characterized by the consumption of fruits, vegetables, fish, grains and cereals. Olive oil is an integral ingredient of the Mediterranean diet and accumulating evidence suggests that it may have health benefits that include reduction of risk factors of coronary heart disease and prevention of certain cancers (Stark et al., 20027). Also, olive oil is known for its high levels on MUFA and phenolic compounds.

Olive oil is often considered the optimal dietary fat for prevention of CVD and certain cancers, and studies support this dietary recommendation (Stark et al., 20027). However, there were no statistical differences in the olive oil consumption by academic majors or by level of education (GRAD versus UND). Yet, in choosing certain type of lipids such as margarine and butter, GRAD did a better job at not consuming these lipids as opposed to UND. That said, the level of education may possibly contribute in the decision making process of what type of lipid to avoid.

This study focused on a group of college students in the College of Health and Human Sciences. One might slightly assume that such a population would be sensitive and knowledgeable about key factors that may influence disease risk. Nevertheless, these

findings suggest that, except for isolated exceptions, the eating behaviors and lipid knowledge of these students is not at a level that could be considered health promoting. This suggests that, even with students in the health sciences, personal health classes are highly to be beneficial in reducing disease prevalence.

Limitations

Forty two percent (n=40) of the subject questionnaires did not fully respond to the questions. Reasons for failure to respond may include: 1) Participants found the questionnaire too long, 2) Participants found the questionnaire too complex, and 3) Participants were not motivated enough to finish. The sample size was not equally distributed between academic majors (NUTR, n=6; RT, n= 9; NURS, n=11; SW, n=8; CJ, n=13; OTH, n= 9) and academic level (GRAD, n=13; UND, n= 43). The questionnaire was relatively long with a total of 96 questions and some of them were not directly related to the research focus, making the analysis more complex. Another limitation to this study was the absence of clarification with regards to margarine. In the study, margarine was considered an unhealthy lipid since the definition for margarine originally came from the legal definition for butter — both contained a minimum of 16% water and a minimum fat content of 80%. However, many brands on the market carry healthy margarine with added plant sterol or stanol. Finally, vegetable oil was used in the questionnaire without specification as what type of lipid it contains. Vegetable oil can be made with canola oil, soybean oil, sunflower oil or a blend, thus the data on vegetable oil were not used in the analysis.

Future studies may also need to assess the consumption of lipids in the college population with larger sample sizes and specific questions on both, knowledge and behavior.

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APPENDIX A: QUESTIONNAIRE

(This Questionnaire is confidential. Do not write your name or other identifying information anywhere on the questionnaire)

1. **Gender**: _____(a) Male _____(b) Female

2. **Age**: ____years

3. **Ethnicity**: _____(a) American Indian/Alaskan Native
   _____(b) Asian
   _____(c) Black or African American
   _____(d) Hispanic
   _____(f) Native Hawaiian and other Pacific Islander
   _____(g) White
   _____(h) Other: Please specify_____

4. **Status**: _____(a) Graduate Student
   _____(b) Undergraduate Student

5. **Concentration**: _____(a) Nutrition
   _____(b) Respiratory
   _____(c) Physical Therapy
   _____(d) Nursing
   _____(e) Social Work
   _____(f) Criminal Justice
   _____(g) Other: Indicate_____

6. **In general, do you read food label:** ____(yes) ____(no)

7. **Do you look at labels of salad dressing**: ____(yes) ____(no)

8. **If you answered 'yes' at question 7, please respond to the following: What is the most important element in salad dressing you look at?**
   ____(a) Total Fat
   ____(b) Carbohydrate (sugar)
   ____(c) Type of Oil (canola, vegetable, etc…)
   ____(d) Total Calories

Do You Like	Not at all 1	2	Somewhat 3	4	Very much 5
9.Olive oil?					
10. Margarine?					
11.Canola oil?					
12. Peanut oil?					
13. Sunflower oil?					
14. Corn oil?					
15. Soybean oil?					
16. Vegetable oil?					
17. Butter?					

Which of the following would you rather eat as your primary source of fat?	Not at all 1	2	Somewhat 3	4	Very much 5
18. Butter					
19. Margarine					
20. Canola Oil					
21. Peanut Oil					
22.Olive Oil					
23.Sunflower Oil					
24. Corn Oil					
25. Soybean Oil					
26. Vegetable Oil					

How often do you consume the following?	Not at all 1	Occasionally 2	Somewhat 3	Often 4	Only oil used 5	I don't know
27. Olive oil						
28. Butter						
29. Canola oil						
30. Vegetable oil						
31. Peanut oil						
32. Corn oil						
33. Margarine						
34. Sunflower oil						
35. Soybean oil						

Which of the following would you use for the following cooking methods?	Olive oil	Butter	Canola oil	Veget-able oil	Peanut oil	Corn oil	Marg-arine	Sun-flower oil	Soy-bean oil
36. Frying									
37. Sautéing									
38. Salad dressing/Garnish									
39. Microwave cooking									
40.Grilling/marinating									
41. Stir-frying									

Basic knowledge (Please mark all that apply)	Saturated fat 1	Mono-unsaturated fat 2	Poly-unsaturated fat 3	Trans fats 4	Polyphenols 5	I don't know 6
42. Butter contains						
43. Margarine contains						
44. Canola oil contains						
45. Peanut oil contains						
46. Olive oil contains						
47. Sunflower oil contains						
48. Corn oil contains						
49. Soybean oil contains						
50. Vegetable oil contains						

Question:	Not at all 1	2	Somewhat 3	4	Very much 5
51.Skipping meals (i.e. breakfast) will help me lose weight					
52. Monounsaturated fat exerts a protection against heart disease risk					
53. Polyunsaturated fat exerts a protection against heart disease					
54. Saturated fat exerts a protection against heart disease					
55. A diet high in saturated fat increases the risk of heart disease					
56. A diet high in unsaturated fat increases the risk of heart disease					
57. A diet high in polyunsaturated fat increases the risk of heart disease					
58. All fats are bad and should be restricted as much as possible					
59. All fats are good and should not be restricted from the diet					
60.The Mediterranean Diet in lower risk of cancer and heart disease					

Is the following associated with lower cancer and lower coronary heart disease mortality rate?	**Not at all 1**	**2**	**Some-what 3**	**4**	**Very much 5**	**I don't know 6**
61. Butter						
62. Margarine						
63. Canola oil						
64. Peanut oil						
65. Olive oil						
66. Sunflower oil						
67. Corn oil						
68. Soybean oil						
69. Vegetable oil						

Of the following foods, which are normally in your kitchen? (Check all that apply)	**Never 1**	**2**	**Some-times 3**	**4**	**Always 5**
70. Bacon					
71. Butter					
72. Candies					
73. Canola oil					
74. Diet soft drinks					
75. Fruits/Vegetables					
76. Fat free salad dressing					
77. Salad dressing					
78. Low fat dressing					
79. Margarine					
80. Nuts					
81. Olive oil					
82. Potatoes chips					
83. Skim milk (or fat free dairy products)					
84. Soft drinks					
85. Vegetable oil					
86. White bread (or unrefined starches)					
87. Whole dairy products					
88. Whole grain bread/ cereal					

What does "choosing healthy fats" means to you?	**Not true 1**	**2**	**Some-what true 3**	**4**	**Com-pletely true 5**
89. Use more plant oil for cooking					
90. Use more animal fat for cooking					
91. Use more margarine					
92.Use more olive oil					
93. Use more hydrogenated oil					
94. Eat at least one good source of omega-3 fats each day					
95. Eat more nuts and seeds					
96. Use more skim milk and low fat dairy products					

APPENDIX B: IRB APPROVAL

INSTITUTIONAL REVIEW BOARD

Mail: P.O. Box 3999
Atlanta, Georgia 30302-3999
Phone: 404/413-3500
Fax: 404/413-3504

In Person: Alumni Hall
30 Courtland St, Suite 217

March 25, 2009

Principal Investigator: Benardot, Dan

Student PI: Samir Benyazza

Protocol Department: Nutrition

Protocol Title: Substances in olive oil with health promoting properties.
Submission Type: Protocol H09399

Review Type: Exempt Review

Approval Date: March 24, 2009

The Georgia State University Institutional Review Board (IRB) reviewed and approved your IRB protocol entitled Substances in olive oil with health promoting properties.. The approval date is listed above. Exempt protocols do not require yearly renewal. However, if any changes occur in the protocol that would change the category of review, you must re-submit the protocol for IRB review. When the protocol is complete, a Study Closure Form must be submitted to the IRB. Any adverse reactions or problems resulting from this investigation must be reported immediately to the University Institutional Review Board. For more information, please visit our website at www.gsu.edu/irb.

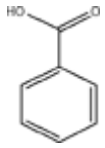
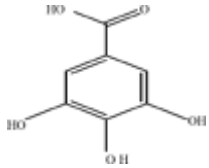
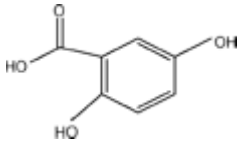
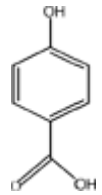
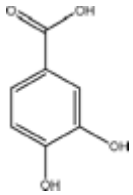
Sincerely,
Tai Wang, IRB Vice-Chair

Federal Wide Assurance Number: 00000129

APPENDIX C: PHENOLIC COMPOUNDS

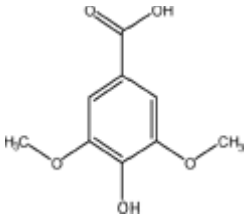
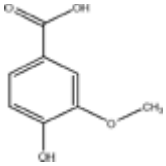
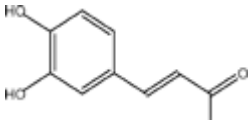
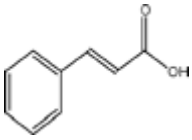
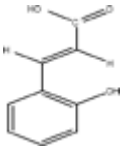
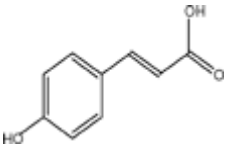
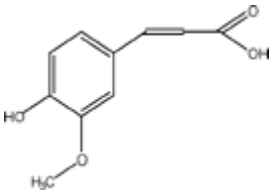
Appendix C. Concentrations of the different classes of phenolics present in virgin olive oil.

Source: Cicerale S, Conlan X, Sinclair A, Keast R. Chemistry and Health of Olive Oil Phenolics. *Critical Review in Food Science and Nutrition*. 2009;49: 218-236.

Name of compound	**Structure**	**Quantity in extra virgin and virgin olive oil (mg/kg)**
Benzoic acid		NA
Gallic acid		0.1-1.4
Gentistic acid		0.3-1.5
p-Hydroxybenzoic acid/ 4-Hydroxybenzoic acid		NQ
Protocatechuic acid/ 3,4-Dihydroxybezoic acid		0.03-1.8

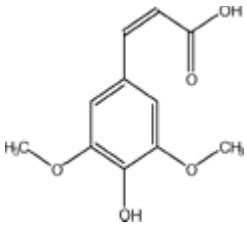
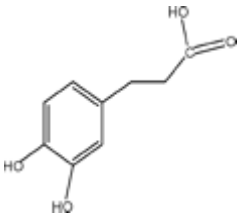
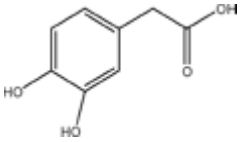
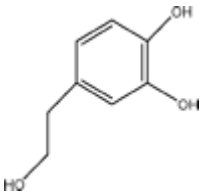
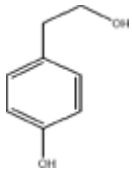
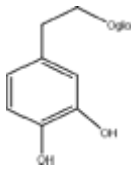
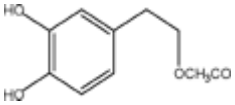
Appendix C. Concentrations of the different classes of phenolics present in virgin olive oil.

Source: Cicerale S, Conlan X, Sinclair A, Keast R. Chemistry and Health of Olive Oil Phenolics. *Critical Review in Food Science and Nutrition*. 2009;49: 218-236.

Name of compound	**Structure**	**Quantity in extra virgin and virgin olive oil (mg/kg)**
Syringic acid		NA
Vanillic acid/ 4-hydroxy-3-methoxy phenylacetic acid		0.2-0.4
Caffeic acid		NQ, 0.04-0.2
Cinnamic acid		NA
o-Coumaric acid		NQ, 0.07-0.1
p-Coumaric acid/4-Coumaric acid		NQ, 0.1-0.4
Ferulic acid		0.02-0.4

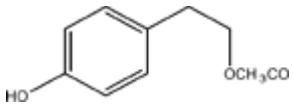
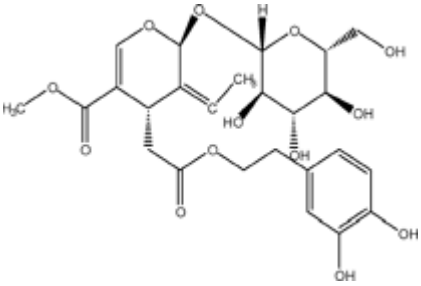
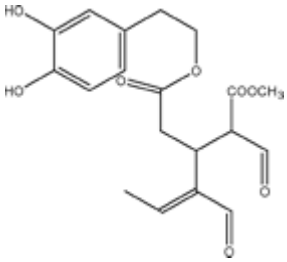
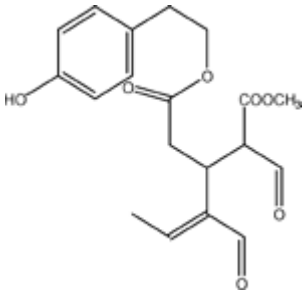
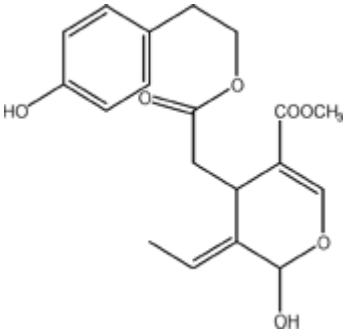
Appendix C. Concentrations of the different classes of phenolics present in virgin olive oil.

Source: Cicerale S, Conlan X, Sinclair A, Keast R. Chemistry and Health of Olive Oil Phenolics. *Critical Review in Food Science and Nutrition*. 2009;49: 218-236.

Name of compound	**Structure**	**Quantity in extra virgin and virgin olive oil (mg/kg)**
Sinapic acid/Sinapinic acid/3,5-Dimethoxy-4-hydroxycinnamic acid/ 4-Hydroxy-3,5-dimethoxycinnamic acid/3-(4-hydroxy-3,5-dimethoxyphenyl) prop-2-enoic acid		0.4
4-(Acetoxy-ethyl)-1, 2-dihydroxybenzene		NA
DOPAC/3,4-dihydroxyphenylacetic acid/4-hydroxyphenylacetic acid		NQ, 0.07
Hydroxytyrosol/ 2-(3,4-Dihydroxyphenyl) ethanol/ 3,4-DHPEA		0.5-14.4
Tyrosol p-Hydroxyphenyl ethanol/ 4-Hydroxyphenylethanol/ p-HPEA		0.5-14.4
(3,4-Dihydroxyphenyl) ethanol-glucoside		NA
2-(3-4 Dihydroxy phenyl) ethyl acetate		NA

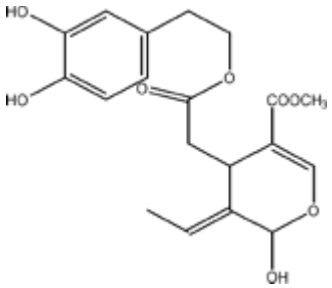
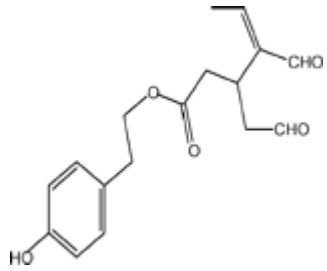
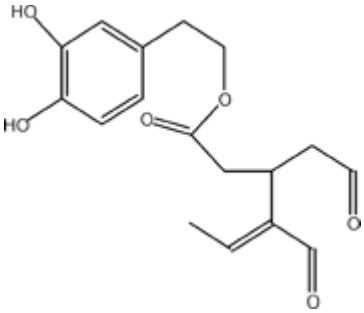
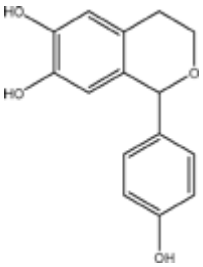
Appendix C. Concentrations of the different classes of phenolics present in virgin olive oil.

Source: Cicerale S, Conlan X, Sinclair A, Keast R. Chemistry and Health of Olive Oil Phenolics. *Critical Review in Food Science and Nutrition*. 2009;49: 218-236.

Name of compound	**Structure**	**Quantity in extra virgin and virgin olive oil (mg/kg)**
2-(4-hydroxyphenyl) ethyl acetate		NA
Oleuropein		2.0
Dialdehydic form of oleuropein aglycon		NA
Dialdehydic form of ligstroside aglycon		NA
Ligstroside aglycon		0.8-44.4

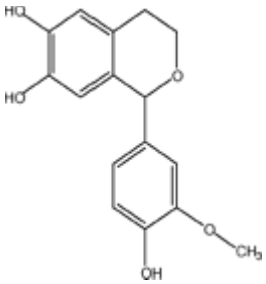
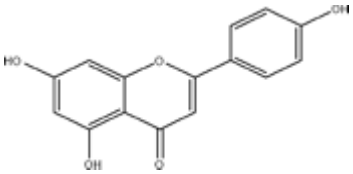
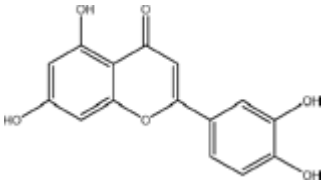
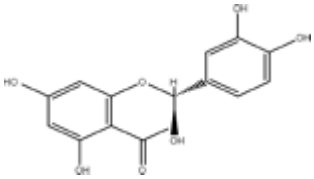
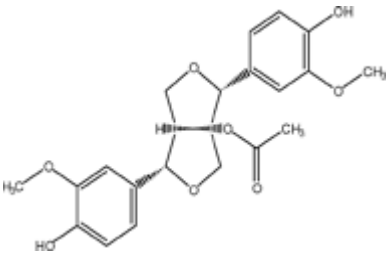
Appendix C. Concentrations of the different classes of phenolics present in virgin olive oil.

Source: Cicerale S, Conlan X, Sinclair A, Keast R. Chemistry and Health of Olive Oil Phenolics. *Critical Review in Food Science and Nutrition*. 2009;49: 218-236.

Name of compound	**Structure**	**Quantity in extra virgin and virgin olive oil (mg/kg)**
Oleuropein aglycon/3,4-DHPEA-EA		1.8-351.7
Oleocanthal/Deacetoxy-ligstroside aglycone/Dialdehydic form of decarboxy methyl elenolic acid linked to *p*-HPEA/*p*-HPEA-EDA		8.4-298.1
Dialdehydic form of decarboxymethyl elenolic acid linked to 3,4-DHPEA/ 3,4-DHPEA-EDA		4.7-522.2
1-phenyl-6,7-dihydroxy-isochroman		NA

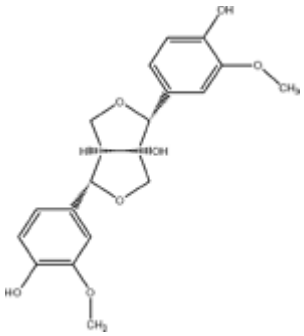
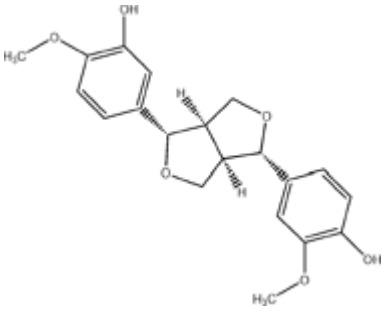
Appendix C. Concentrations of the different classes of phenolics present in virgin olive oil.

Source: Cicerale S, Conlan X, Sinclair A, Keast R. Chemistry and Health of Olive Oil Phenolics. *Critical Review in Food Science and Nutrition*. 2009;49: 218-236.

Name of compound	**Structure**	**Quantity in extra virgin and virgin olive oil (mg/kg)**
1-(3'-methoxy-4'-hydroxy)phenyl-6,7-dihydroxy-isochroman		NA
Apigenin		0.4-2.2
Luteolin		0.2-7.6
(+)- Taxifolin		NQ, 129.4
(+)-1- Acetoxypinoresinol		0.2-36.2

Appendix C. Concentrations of the different classes of phenolics present in virgin olive oil.

Source: Cicerale S, Conlan X, Sinclair A, Keast R. Chemistry and Health of Olive Oil Phenolics. *Critical Review in Food Science and Nutrition*. 2009;49: 218-236.

Name of compound	**Structure**	**Quantity in extra virgin and virgin olive oil (mg/kg)**
(+)-1-Hydroxypinoresinol		NA
(+)- Pinoresinol		0.5-34.1

NA= Not available, NQ= Non quantifiable

Source: Cicerale S, Conlan X, Sinclair A, Keast R. Chemistry and Health of Olive Oil Phenolics. *Critical Review in Food Science and Nutrition*. 2009;49: 218-236.

TABLES

Table 1: Consumption of Olive Oil and Production			
Country	**Production (2005)**	**Consumption (2005)**	**Annual per capita consumption (kg)**
Spain	32%	20%	13.62
Italy	22%	30%	12.35
Greece	16%	9%	23.7
Tunisia	7%	2%	11.1
Turkey	5%	2%	15
Syria	4%	3%	7
Morocco	3%	2%	1.8
Portugal	1%	2%	7.1
United States	0%	8%	0.56
France	0%	4%	1.34
Others	10%	18%	1.18

Table 2: Olive Oil Sales in US Markets	
1994-1995	+12%
1995-1996	+27%
1996-1997	+31%
1997-1998	+18%
1999-2000	+10%
2000-2001	+1%
1991 to 2003	+100%

Table 3. Mean and standard deviation: Consumption of different oils.

Oils	M X (sd)	F X (sd)	GRAD X (sd)	UND X (sd)	NUTR X (sd)	RT X (sd)	NURS X (sd)	SW X (sd)	CJ X (sd)	OTH X (sd)
Olive Oil	3.92(.99)	3.70(1.1)	3.46(1.19)	3.84(1.09)	4.33(.51)	3.78(1.20)	4.18(1.16)	3.38(.91)	3.77(1.09)	3.11(1.26)
Butter	2.58(.90)	3.11(1.33)	2.54(.87)	3.14(1.33)	2.33(1.03)	3.00(1.11)	3.36(1.74)	3.00(.92)	3.08(1.38)	2.89(1.05)
Canola Oil	2.25(1.13)	3.20(1.56)	2.77(1.36)	3.07(1.58)	3.00(1.26)	1.89(1.53)	3.73(1.61)	2.75(1.28)	3.00(1.22)	3.44(1.81)
Veg Oil	2.42(.99)	3.05(1.50)	2.15[2](.80)	3.14[2](1.50)	2.00(.63)	1.89(1.36)	3.55(1.80)	2.88(.99)	3.23(1.42)	3.33(1.11)
Peanut Oil	2.33(1.72)	2.61(1.96)	1.46[3](.66)	2.88[3](2.03)	1.33(.51)	1.78(1.64)	2.82(2.13)	1.75(.70)	3.69(2.05)	2.89(2.20)
Corn Oil	2.08[1](1.56)	2.68[1](2.06)	1.77[4](1.36)	2.79[4](2.07)	2.33(1.86)	1.56(1.66)	3.18(1.99)	1.75(1.03)	3.31(2.28)	2.56(2.18)
Margarine	2.00(1.12)	2.11(1.45)	1.46[5](.51)	2.28[5](1.50)	1.33(.51)	1.56(1.01)	2.55(1.96)	1.88(.35)	2.54(1.66)	2.11(1.16)
Sunflow Oil	1.92(1.92)	2.50(2.02)	1.77[6](1.48)	2.56[6](2.11)	2.17(2.04)	1.56(1.66)	2.73(2.14)	1.63(1.06)	3.15(2.37)	2.44(2.12)
Soybean Oil	1.58(1.50)	2.48(1.89)	1.77[7](1.01)	2.44[7](2.01)	2.00(1.26)	1.67(1.65)	2.91(1.75)	1.75(1.16)	2.77(2.31)	2.11(2.20)

[1] P=0.04 between M and F
[2] P=0.008 between Grad and Und
[3] P=0.000 between Grad and Und
[4] P=0.002 between Grad and Und
[5] P=0.004 between Grad and Und
[6] P=0.022 between Grad and Und
[7] P=0.005 between Grad and Und

Table 4. Mean and standard deviation: Purchase of common foods (Of the following foods, which are normally in your kitchen?)

	M X (sd)	F X (sd)	Grad X (sd)	Und X (sd)	Nutr X (sd)	RT X (sd)	Nurs X (sd)	SW X (sd)	CJ X (sd)	O X (sd)
Bacon	2.58(1.50)	2.25(1.34)	2.00(1.22)	2.42(1.41)	1.67(.81)	2.00(1.41)	2.00(.89)	2.63(1.68)	2.62(1.71)	2.78(1.30)
Butter	3.42(1.31)	3.66(1.46)	3.77(1.30)	3.56(1.46)	3.33(1.50)	3.67(1.50)	3.36(1.74)	4.13(1.24)	3.38(1.60)	3.89(.78)
Candies	3.08[1](1.73)	2.57[1](1.28)	2.46(1.45)	2.74(1.38)	2.67(1.50)	2.89(1.69)	2.18(1.07)	1.88(.83)	3.15(1.28)	3.11(1.69)
Canola oil	3.17(1.33)	2.86(1.65)	3.85(1.34)	2.65(1.55)	4.17(.98)	2.33(1.65)	2.36(1.20)	3.38(1.76)	2.92(1.60)	3.00(1.80)
Diet soft drinks	2.67(1.67)	2.43(1.59)	2.69(1.65)	2.42(1.59)	3.17(1.83)	1.56(1.33)	3.00(1.48)	1.38(.74)	3.00(1.73)	2.56(1.59)
Fruits/Vegetables	4.25[2](1.05)	4.64[2](.71)	4.77(.59)	4.49(.85)	4.83(.40)	4.33(1.11)	4.73(.46)	4.88(.35)	4.00(1.08)	4.89(.33)
Fat free salad dressing	2.92(1.16)	2.89(1.41)	2.77(1.23)	2.93(1.40)	2.83(.93)	2.56(1.01)	3.55(1.21)	2.63(1.50)	2.92(1.49)	2.67(1.73)
Salad dressing	3.75(1.42)	3.77(1.41)	3.77(1.58)	3.77(1.36)	3.00(1.78)	4.67(.70)	3.55(1.29)	4.13(1.12)	3.38(1.55)	3.89(1.53)
Low fat dressing	3.08[3](1.16)	2.95[3](1.59)	3.00(1.29)	2.98(1.58)	3.17(1.32)	2.89(1.36)	2.91(1.75)	2.75(1.58)	3.23(1.64)	2.89(1.53)
Margarine	2.83(1.52)	2.27(1.33)	2.15(1.46)	2.47(1.36)	1.67(1.21)	2.33(1.73)	2.18(.87)	1.88(1.12)	3.08(1.49)	2.67(1.50)
Nuts	3.83(1.46)	3.52(1.42)	3.69(1.70)	3.56(1.35)	4.83(.40)	3.56(1.42)	4.09(.83)	3.50(1.77)	3.00(1.47)	3.11(1.61)
Olive oil	4.67[4](.65)	4.23[4](1.07)	4.31(1.18)	4.33(.96)	5.00(.00)	4.56(1.01)	4.36(.92)	4.50(1.06)	3.85(1.21)	4.11(.92)
Potatoes chips	3.17(1.46)	2.55(1.15)	2.15(1.06)	2.84(1.25)	1.83(1.16)	2.67(1.32)	2.55(1.12)	2.38(.51)	3.08(1.18)	3.11(1.69)
Skim milk	2.92(1.78)	3.66(1.68)	3.69(1.75)	3.44(1.72)	4.83(.40)	3.33(1.87)	3.64(1.62)	3.25(1.90)	3.62(1.85)	2.67(1.65)

Table 5. Mean and standard deviation: Fats and oils knowledge (Does the fat/oil in question contain saturated fat, MUFA, PUFA, transfat or polyphenols?)

Oils	M X (sd)	F X (sd)	Grad X (sd)	Und X (sd)	Nutr X (sd)	RT X (sd)	Nurs X (sd)	SW X (sd)	CJ X (sd)	O X (sd)
Butter	2.50(2.27)	2.93(2.20)	1.69[1](1.54)	3.19[1](2.20)	1.50(1.22)	2.44(2.24)	2.45(2.11)	2.75(2.25)	3.77(2.38)	3.33(2.34)
Margarine	3.75(2.41)	3.66(2.18)	2.54(1.98)	4.02(2.18)	2.50(1.63)	3.00(2.44)	3.45(2.11)	3.38(2.38)	4.38(2.18)	4.67(2.17)
Canola Oil	4.33(1.82)	4.52(1.99)	3.46(1.89)	4.79(1.87)	3.33(1.36)	3.78(2.22)	3.64(2.15)	4.88(2.10)	4.92(1.75)	6.00(.00)
Peanut Oil	4.33(1.77)	4.77(1.89)	3.85(2.11)	4.93(1.72)	3.83(2.13)	4.11(2.31)	4.18(1.94)	5.38(1.76)	4.69(1.75)	5.78(0.66)
Olive Oil	4.58(1.83)	4.61(1.80)	3.85(1.72)	4.84(1.77)	4.00(1.54)	4.78(1.92)	3.45(1.86)	5.38(1.40)	4.54(1.98)	5.67(1.00)
Soft drinks	2.75(1.48)	2.48(1.37)	1.92(1.11)	2.72(1.42)	1.50(.54)	2.33(1.50)	2.91(1.30)	2.00(1.41)	3.00(1.47)	2.78(1.39)
Vegetable oil	3.58(1.24)	3.23(1.32)	3.08(1.03)	3.37(1.38)	2.67(.81)	2.33[5](1.00)	3.18(1.40)	3.88(1.24)	3.38(1.38)	4.22[5](.97)
White bread	2.50(1.50)	2.50(1.90)	2.38(1.44)	2.93(1.32)	2.33(1.03)	3.00(1.80)	2.35(1.50)	1.75(1.38)	2.50(1.60)	1.89(1.36)
Wholly dairy products	3.33(1.61)	3.23(1.32)	2.54(1.61)	3.47(1.50)	2.17(1.60)	2.89(1.61)	3.09(1.57)	3.75(1.38)	3.77(1.48)	3.33(.65)
Whole grains/cereal	4.50(.79)	4.68(.70)	4.77(.59)	4.60(.76)	4.83(.40)	4.33(.86)	4.55(1.03)	5.00(.00)	4.62(.65)	4.67(.70)

[1]P=0.020 between M and F
[2]P=0.037 between M and F
[3]P=0.012 between M and F
[4]P=0.005 between M and F
[5]P=0.025 between RT and O

Sunflower Oil	4.33(1.77)	5.05(1.71)	3.85[2](2.03)	5.21[2](1.52)	3.50(1.64)	5.11(1.83)	4.27(1.84)	5.38(1.76)	4.85(1.81)	6.00(.00)
Corn Oil	4.25(1.86)	4.91(1.89)	3.31(2.01)	5.21(1.62)	3.00(1.67)	5.11(1.83)	4.36(2.11)	5.38(1.76)	4.77(1.92)	5.56(1.33)
Soybean Oil	4.25(1.86)	4.91(1.81)	3.38(1.98)	5.19(1.57)	3.33(1.86)	5.11(1.83)	4.09(2.02)	5.25(1.75)	4.92(1.75)	5.56(1.33)
Vegetable Oil	3.75(2.09)	4.55(1.93)	2.69(1.65)	4.88(1.78)	2.33(.81)	4.78(1.98)	4.36(1.80)	5.00(1.92)	4.08(2.32)	5.22(1.56)

[1]P=0.000 between Grad and Under
[2]P=0.026 between Grad and Under