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Dietary Patterns of Mediterranean Adolescents

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DIETARY PATTERNS OF MEDITERRANEAN ADOLESCENTS

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An Abstract of the Thesis Presented in Partial Fulfillment of the Requirements for the Degree of Master of Science (in Food Science and Human Nutrition) August, 2005

The Mediterranean Diet (MD) is renowned for its health benefits. However, adherence appears to be lessening in the Mediterranean region as rates of overweight, obesity, and chronic disease are increasing. The adoption of a “western diet” (high amounts of meats, refined grains, snacks, and fast-food products) has been termed the “Nutrition Transition”. Adolescents appear to be the most affected; therefore their diets and eating patterns were examined in this study. The objectives were to study food group-based consumption of adolescents, compare average servings with recommendations from the USDA Food Guide Pyramid (FGP) and the MD Pyramid, identify and compare eating patterns between sexes, and relate these findings to research from other countries. One hundred thirteen adolescents (mean age of 17.6 ± 1.7) participated in the Harokopio Nutritional Assessment Study (HNA). They were required to complete a 3-day food diary (two consecutive week days and one week-end day) as well as a demographic questionnaire from which a food group-based assessment was conducted. Dietary patterns were evaluated at seven time intervals during the day. Males
had significantly greater Body Mass Index and significantly lower percentages of body fat than females. Approximately 34.5% of the students reported only light or sedentary exercise habits, 57.5% reported that they did not smoke and 90% reported that they did not consume alcohol. Males consumed significantly greater amounts of grains, vegetables, potatoes, French fries, medium-fat and red meats, dairy products, sweetened beverages, teaspoons of fat, gyros, and pizza. Neither males nor females met the USDA FGP or the MD Pyramid recommendations for fruits or vegetables and females did not meet the three a day recommendation by the USDA FGP for dairy products or the MD Pyramid recommendation for grains. Males greatly exceeded the USDA FGP recommendation for total meat and both males and females exceeded the recommendation for teaspoons of oil. According to the MD Pyramid, neither males nor females met the recommendations for fish or poultry. However, both exceeded the MD recommendation for sweets, potatoes, and red meat. In fact, on a daily basis, males consumed 20 times and females consumed 14 times the recommendation for red meat. For most, the dietary pattern of no breakfast, a mid-day meal (somewhere between 12:00 – 3:59pm) and an evening meal (8:00 – 10:59pm) was revealed. Males consumed significantly greater amounts of foods in the evening between 11:00 – 2:59am. Smoking had positive correlations with coffee and reported alcohol consumption, and a negative correlation with reported exercise. It is apparent that this population no longer followed the traditional eating patterns of the MD. This study documented a high consumption of meats, refined grains, and fast foods; and a low consumption of fruits and vegetables and low activity levels. This has also been reported in countries undergoing the Nutrition Transition. Adolescent independence in making food choices makes this period an
opportune time for nutrition education to be offered in an effort to prevent the
development of nutrition-related diseases later in life.
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Chapter 1

INTRODUCTION

The Mediterranean Diet (MD) has been hailed as a healthful and disease preventative approach to eating. When it was first researched in the 1950's, it was apparent that diet and lifestyle was of significant value in the longevity and health of the peoples of the Mediterranean region (Keys, 1980). Recently, it has come to the attention of researchers that rates of obesity and chronic disease are increasing in this population and that the typical healthful aspects of the MD may be fading (Trichopoulou & Efstathiadis, 1989; Savaa, et al., 2002; Yannakoulia, et al., 2004a; Magkos, et al., 2005).

Since the end of World War II, economic growth in Greece has been associated with a decrease in premature mortality as well as an increase in chronic disease and cancer. Even more interesting is that as rates of cerebrovascular disease and ischemic heart disease appear to be decreasing in many European countries, these trends in Greece are increasing. There is some evidence to support the practice of the MD is now being influenced by adoption of Western habits such as increased soda consumption, fast foods, and snacking patterns (Farthing, 1991; Cavadini, et al., 2000; Videon & Manning, 2003). This situation may be particularly true in the Mediterranean adolescent population.

The influence of Western dietary habits on the MD has been termed the "Nutrition Transition" and is the consequence of globalization, urbanization, and an increased Gross National Product of developed and developing countries (Pekka, et al., 2004). With increased food selections, media promoting snack and fast-food products, and a greater income to purchase these products, dietary intake of the population is higher.

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in the above food products (Farthing, 1991; Cavadini, et al., 2000). In combination with poor snacking choices and increasingly sedentary lifestyles, rates of nutrition-related non-communicable diseases are on the rise in both Greece and in the U. S. (Klimis et al., 2000; Story & Resnick, 1986).

This diet transition is of great concern since the MD dietary patterns which have been revered for their health benefits and have been shown to prevent disease and some cancers (Trichopoulou, et al., 2005; Bingham, et al., 2003) do not appear to be lasting through the adolescent age of those who were raised on them (Klimis, et al., 2001). If the very persons who grew up on this diet are no longer following it, it will be difficult to introduce its practices and importance into the lives of adolescents around the world who were not raised on it. Therefore, it is important to study the diet and habits of these adolescents, particularly in Greece, to examine whether the "nutrition transition" can be detected in the Greek adolescent diet. Hence, the Harokopio Nutrition Assessment Study (HNA) was conducted among Greek adolescents. Data for this thesis were derived from the above HNA nutrition assessment study.
The goals of this thesis were to describe the dietary patterns of Greek male and female adolescents and compare them to adolescents of other countries. The objectives included:

- to study food-group based consumption of adolescents and compare the findings to the recommendations of the USDA Food Guide Pyramid and the MD Pyramid,
- to identify eating patterns of male and female subjects, (including types of foods and times consumed), and determine the extent to which those patterns differ between sexes and
- to compare these findings to research studies from other countries.

It is hopeful that findings from this study will assist in determining specific areas of nutrition-related problems and offer clues in an effort to develop educational material to reinforce healthy eating patterns in the diets of Greek adolescents as well as the diets of adolescents around the world.
Chapter 2
LITERATURE REVIEW

Mediterranean Diet

After the Second World War, the government of Greece asked the Rockefeller Foundation to complete an epidemiological survey of food handling, supply, production, and consumption on the island of Crete. Results demonstrated that the typical Cretan diet was composed of 60% of kcalories from carbohydrates, primarily from plant and grain foods, 30-40% kcalories from fats (mostly polyunsaturated and monounsaturated), and only approximately 7% from animal products, including fish and dairy. The report commented that foods seemed to be "swimming in oil" (Albaugh, 1953).

The Mediterranean Diet (MD) was first documented and researched in the 1950’s in The Seven Countries Study conducted by Dr. Ancel Keys and colleagues (Keys, et al., 1986). This study compared the health of persons on the island of Crete in Greece with the other countries such as: Finland, Italy, Japan, the Netherlands, Yugoslavia, and the United States. The researchers found that Greek Cretan men had the lowest rates of cardiovascular disease as compared with Europe and the United States and that the rates of mortality statistics were seven times lower than those in the United States (Keys, 1980; Keys, et al., 1986).

It was apparent that despite a high percentage of calories from fat in this population, they had a long life expectancy and very low rates of coronary heart disease and cancer (Keys, et al., 1980). Their good health was attributed to the traditional dietary patterns which included copious amounts of plant foods, including fruits, vegetables,
offers protection from infections. Srinath & Katan (2004) add that a Mediterranean style diet can be protective against hypertension, stroke, and coronary heart disease. In a review of studies on the MD and total mortality, Panagiotakos, et al (2004) showed that in all studies, adherence to a MD reduced all causes of death by 8-45%. In a recent study from Quebec, oxidized LDL (ox-LDL) scores were evaluated in women pre and post twelve weeks on the MD (Lapointe, et al., 2005). The researchers found an 11.3% decrease in plasma ox-LDL concentrations which was even more significant in women with higher baseline oxidized LDL levels. Thus, adherence to a Mediterranean-style diet seems to prevent chronic disease and illness in all populations evaluated and is recommended for use for all individuals.

**Food Guide Pyramid Recommendations**

Nutrient guidelines focus on individual nutrient recommendations for adequate consumption of macro- and micronutrients in the diet, such as individual vitamins and minerals. Food-based guidelines utilize whole foods, such as servings of fruits and vegetables, to express dietary recommendations. Both nutrient guidelines and food-based guidelines are used in most countries, including Greece and the United States, to communicate dietary recommendations to the public. However, nutrient guidelines are more specific and are more often used by Dietitians and other health professionals, while food-based guidelines are easier to comprehend and are better accepted by the general public (Haraldsdottir, 1999).
As discussed above, Greece utilizes recommendations according to the traditional MD. The MD recommendations are based on data from longitudinal studies in the Mediterranean region such as the Seven Countries Study (Keys, 1980), the European Prospective Investigation into Cancer and Nutrition (EPIC study) conducted by Dr. Trichopoulou and others (Bingham et al., 2003; Trichopoulou et al., 2005), as well as research by Moschandreas & Kafatos (1999), and Kafatos et al (1997). The MD Pyramid was designed according to these recommendations by a diverse body of scientists from Greece and the United States, including Dr. Antonia Trichopoulou and Dr. Pagona Lagiou, as well as public health officials from the Hellenic Ministry of Health in Greece and The Greek Public Health Committee (Hellenic Ministry of Health and Welfare, 1999). Refer to Appendix A to view the MD Pyramid. In the United States, the USDA Food Guide Pyramid (FGP) is used to express food group serving recommendations.

Grains.

Grains are great sources of fiber, B vitamins, selenium, iron, and magnesium. Adequate grain consumption has been linked to reductions in the risk of diverticulosis and constipation as well as cardiovascular disease. However, the population must discern between the more processed grains and whole grain products (Lorenz & Lee, 1977; Bingham, et al., 2003). The MD Pyramid suggests an average of eight servings, preferably non-refined grains and cereals per day (Hellenic Ministry of Health and Welfare, 1999), while the FGP suggests a range of six to eleven daily servings. The new USDA FGP also offers adjusted recommendations for age, sex, and average amount of physical activity. For instance, it is suggested that females between the ages of 10-18
who participate in approximately 30-60 minutes of activity per day consume six servings of grains per day and males between the ages of 17-25 consume approximately ten servings of grains per day.

**Fruits and vegetables.**

Fruits and vegetables are loaded with vitamins and minerals including (but not limited to) vitamins A, C, E, iron, folic acid, and potassium and are rich in soluble and insoluble fiber. A diet which includes moderate amounts of fruits and vegetables has been inversely associated with risk of coronary heart disease and most cancers (Heber, 2004). Flavonols, which are also abundant in fruits and vegetables, are antioxidants which help to protect lipoproteins from oxidation. They, too, have been shown to decrease the risk of coronary heart disease in healthy individuals (Lapointe, et al., 2005). Recent USDA FGP Recommendations suggest a minimum of three fruits and four vegetables per day for females and four fruits and five vegetables for male adolescents. Guidelines are similar for the MD Pyramid which advises that persons consume six servings of vegetables and at least three servings of fruits each day.

Although potatoes are often categorized under the vegetable group, it is physiologically closer to a refined grain as far as glycemic response is concerned. Potatoes have similar amounts of protein as grain products and are good sources of vitamin C. However, they have a high glycemic index and glycemic load and for this reason have been found to be positively associated with the risk of Type II diabetes (Riccardi, et al., 2003). Current recommendations from the MD suggest that servings of
potatoes not exceed three per week. The USDA FGP does not distinguish potatoes as an individual category.

Many studies have been conducted to evaluate whether certain populations were meeting the recommendations set by their countries. In a study by Flynn & Kearney (1999), average daily fruit and vegetable consumption (not including potatoes) of Irish adults met only 50% of 400 g/day (or five-80g servings) recommendation. In fact, only 5% of the population met this goal (once fruit juice was excluded). Similar results were noticed by O’Brien, et al., (2003) in Scottish adults ages 18-64. They found that not only was the average fruit and vegetable consumption below the recommendation (also 400g/day), but that the lowest intake was in the 18-35 age group, being only approximately 241g/day, of which the vegetables were most often in the form of fried, roasted, and chipped potatoes.

**Dairy.**

Although dairy products are excellent sources of calcium in the diet, they can also be a substantial contributor to the amount of saturated fats one consumes (Guenther, 1986). Therefore, low fat and fat free dairy products are the choices most recommended (Hellenic Ministry of Health and Welfare, 1999). Both the USDA FGP and the MD Pyramid suggest that servings of dairy products including milk, yogurt, and cheese be consumed at least twice daily; however, the USDA FGP suggests an additional serving of dairy in the adolescent population.
Recently, dairy consumption has been linked to weight loss. Zemel (2004) states that a high calcium diet decreases adipocyte lipid accumulation, thereby helping to prevent weight gain, increases lipolysis, and maintains thermogenesis while dieting which helps to increase weight loss. However, this theory remains controversial; as Lanou (2005) comments, the data do not support the conclusion that dairy products are useful in weight loss.

**Meats and meat products.**

Meats and eggs are excellent sources of high quality protein and are abundant in B vitamins and trace minerals such as selenium, iron, and zinc. Hill (2002) discusses the associations of overindulgence in meat, particularly in red meat, with colorectal cancer and other forms of cancer and coronary heart disease, but also mentions that these correlations remain controversial. It is also of note to mention that Menghetti, et al., (2004) found significant correlations between excessive protein intake and risk of hypertension in obese children. Frank, et al., (1992) also noted that total protein had a significant positive association with systolic blood pressure, but an inverse association with body mass index in adolescents. Suggestive servings for the above foods from the Mediterranean recommendations include: no more than four servings of poultry per week, no more than three eggs per week, and as rarely as four servings per month for servings of red meat. Unlike the MD Pyramid, the FGP does not distinguish between different protein items as separate groups, but combines all meats and meat products (including legumes, nuts, and fish) into a single group. However, the suggestion to choose fish, poultry and meat-substitutes versus red and processed meats is discussed on
the website (www.mypyramid.gov). It is specified that a minimum of two to three servings be chosen from this group daily.

**Nuts, legumes, and pulses**

Nuts are a good source of monounsaturated fatty acids and nuts, including almonds and walnuts, are considered preventative against ischemic and coronary heart disease (Sabate, 1993; Kris-Etherton et al., 2001), and have hypocholesterolemic effects (Fraser, 1999). Seeds and nuts also have a high content of vitamin E and fiber (Kris-Etherton, et al., 2001). Pulses, seeds, and nuts are placed under the same category in the MD and it is recommended that approximately three to four servings per week be consumed. The FGP does not distinguish nuts or legumes as a separate group, but categorizes them under the meats and meat-substitutes group.

**Fish**

Omega-3-poly unsaturated fatty acids found in fish oil, such as eicosapentanoic acid (EPA) and docohexanoic acid (DHA) (as well as in plants as alpha linolenic acid) have been identified as having a significant role in the prevention of coronary heart disease, possibly secondary to their anti-thrombotic effects (Harper & Jacobson, 2003). Eicosapentanoic acid has also been attributed to alleviation of mood disorders (Ohara, 2005) and preventing cancer cachexia (Inui, 2002). According to the MD, it is recommended that five to six servings of oily fish products be consumed weekly. Fish is also not classified as an individual category, but is grouped together with the meats and meat-substitutes group in the FGP.
Fats and Oils.

Olives and olive oil have been shown to have benefits of their own as well. Olives (particularly those that have not been subjected to brining) can contain up to 16 g/kg of antioxidants including acteosides, hydroxytyrosol, and tyrosol. Although olive oil contains lesser amounts of hydroxytyrosol and tyrosol, it is rich in secoiridoids and lignans. Both contain anticancer agents including squalene and terpenoids as well as oleic acid which is more resistant to oxidation. Therefore, it seems arguable that olive and olive oil consumption provides many beneficial effects on health (Owens, et al., 2004). It has been concluded that olives and olive oil may reduce the risk of ovarian cancer (Tzonou, et al., 1993), have a protective effect against peripheral arterial occlusive disease (Katsouyanni, et al., 1991), and even prevent rheumatoid arthritis (Linos, et al., 1999). However, it must also be added that according to Vissers and colleagues (2004), the amount of phenols absorbed from an estimated average daily consumption of 50 grams of olive oil (or approximately three tablespoons) in persons from the Mediterranean region, would only offer 0.06 micromols/l of the necessary 50-100 micromols necessary to show antioxidant activity in vitro and would most likely not have a major effect on prevention of the above diseases. However, in combination with an overall healthy diet, use of olive oil could prove advantageous (Vissers, et al., 2004). Although an actual recommendation amount is not given, the MD Pyramid devotes an entire group to olive oil and states that it should be used as the main source of lipid in the diet. The recent FGP includes a group for fat consumption, but not specifically for olive oil. It is suggested that the majority of dietary fat come from oils, nuts, and fish rather than saturated fats.
In 2002, Ferro-Luzzi, et al., estimated that the average fat intake in the Greek diet ranged from 35% to 47% of total calories. Similar results were found in Greek children (Roma-Giannikou, et al., 1997) and Greek adolescents (Hassapidou & Fotiadou, 2001; Yannakoulia, et al., 2004b). Ferro-Luzzi, et al., (2002) state that some researchers believe that an effort to reduce olive oil intake could result in a reduction of the consumption of vegetables. However, the above authors found that high-fat consumers were not eating more vegetables than low-fat consumers and vice versa. These high percentages of energy from fat are not limited to the Mediterranean however. Bull & Phil (1992) demonstrated that these percent fat amounts are similar to adolescent fat intakes from other countries including the United States (40%), Australia (40%), and the United Kingdom (43%). As not all fats are equal, saturated fat should be evaluated separately. It is recommended that daily consumption of saturated fat total less than 10% of kcals. The Harokopio Nutrition Assessment Study (HNA) estimated that our population consumed an average of 14.2% saturated fat for females and 13.4% for males (Yannakoulia, et al., 2004b). Similar results were seen by Kafatos, et al., (2000) in children and even higher amounts (approximately 20%) were shown by Trichopoulou, et al., (1993) in adults.

**Alcohol.**

Wine has also been receiving attention for its protective effects on lipoprotein profiles, coagulation and fibrinolysis, platelet aggregation, oxidative mechanisms and endothelial function (Caimi et al, 2003). Wine polyphenols stimulate the expression of genes involved in the nitric-oxide pathway within the arterial wall allowing for improved
vasorelaxation. Panza, et al., (2004) observed that the risk of dementia was lower in a French population who drank three or four glasses of red wine daily as compared with total abstainers. It is of note to mention that the beneficial effects of wine are greater if it is incorporated into a healthy diet. Recent MD guidelines recommend a daily ethanol consumption of approximately 30 grams (or three alcoholic beverages) for men and 15 grams (or one and a half alcoholic beverages) for women, preferably wine with meals (Hellenic Ministry of Health and Welfare, 1999). The current USDA FGP does not include recommendations regarding alcohol consumption. However, the 2005 Dietary Guidelines for Americans suggest that alcohol be limited to one drink per day for women and two drinks per day for men (Advisory Committee, 2005).

**Sweets.**

Both the FGP and the MD Pyramid suggest limiting the intake of sweets and baked goods, but the MD Pyramid offers a numerical suggestion of less than three servings per week. Sugars and sweets have been identified as leading causes of dental caries, but high consumption of these foods has also been linked to an inability to eat a nutritious diet at an energy level that can maintain a healthy weight (Guthrie & Morton, 2000). Servings of sugar as daily amounts of teaspoons have been suggested as follows: no more than 6 tsp/day at 1,600 kcals, 12 tsp/day at 2,200 kcals and 18 tsp/day at 2,800 kcals. These amounts range from 6-10% of energy (Hellenic Ministry of Health and Welfare, 1999). The USDA FGP does not include a recommendation for sweets or added sugars.
Adolescence

Adolescence is a transitional period of development and decision making in a person’s life. Lifestyle and eating behaviors evolve and are typically characterized by irregular meal patterns, snacking or ‘grazing’, and meal-skipping (Story, et al., 1986). Farthing (1991) states that teenagers between the ages of twelve and twenty tend to pull away from their parents in an effort to become adults. Adolescents spend more time away from home as a result of social, school, community activities and jobs and therefore, have more freedom in the foods they select (Videon & Manning, 2003). They prepare their own meals and have differing meal times from the rest of their family (Siega-Riz, 1998). Therefore, in place of sit-down family meals, adolescents are consuming many of their meals at fast food restaurants, from vending machines, and as convenient microwavable items (Farthing, 1991).

It is generally assumed (although not actually verified) that much of an adolescent’s eating habits are influenced by their peers (Farthing, 1991). By being preoccupied with their appearance and attempting to fit in, adolescent eating patterns may shift to dieting or consuming fad foods, such as sodas and fast food items (Cavadini, et al., 2000). In a study on eating habits of teenagers in San Francisco Bay, 80% of subjects stated that they frequently met with friends to “pig out”, which was described as a way to have fun while socializing (Farthing, 1991). Meal skipping and snacking were reported by Truswell and Darnton-Hill (1981) and Court (1988). Both found that many adolescents admitted to skipping at least one meal per day which was often substituted with empty calorie snacks. On average, snacks accounted for 20-25% of energy intake in both males and females (Court, 1988). Meal skipping, snacking, and fewer family meals
may result in lower intakes of nutrients and food groups, particularly fruits, vegetables, and dairy products (Videon & Manning, 2003). In fact, according to the United States Department of Agriculture Healthy Index Rating for 1994-1996, 94% of adolescents between the ages of 13 and 18 were identified as consuming poor quality diets or diets in need of improvement (Videon & Manning, 2003).

During adolescence, vitamin and mineral requirements increase as a result of increased energy demand. Higher levels of thiamin, riboflavin, and niacin are needed to allow energy to be released from carbohydrates and folacin as well as vitamin B₁₂ are required for increased tissue synthesis. Vitamins A, C, D, and E are required to compensate for the rapid rate of skeletal growth during this period and to maintain proper structure and function of new cells formed during growth. Minerals including calcium, iron, and zinc are also important in bone growth, expansion of blood volume, and proper generation of skeletal and muscle tissue (Lifshitz, et al., 1993). The above authors also state that failure to consume an adequate diet during adolescence can interrupt growth and pubertal development.

Serra-Majem, et al., (2003) found that Spanish adolescents with a stricter adherence to the MD had greater intakes of vitamins and minerals, while those with less adherence had poor and inadequate intakes of vitamins and minerals. It was concluded that the MD contributes to high nutritional quality and as diet deteriorates, health risks increase. In a nationwide study of U.S. adolescents, Munoz and colleagues (1997) determined that 7.1% of male adolescents and 18.4% of female adolescents did not meet any of the Food Guide recommendations over the course of three days. Surprisingly, only 1% of the male and female population met all guidelines. They also found that fat
and sugar intake was substantially greater than recommended and that recommended servings of fruit were most often not met. The Health Survey for England study (Doyle and Hosfield, 2001) demonstrated that English adolescents between the ages of 16 and 24 consumed only 1.1 servings of fruits (excluding juice) and 0.9 servings of vegetables (excluding pulses) per day. This study evaluated a wide range of ages and determined that there was a positive association between fruit and vegetable consumption and age. Therefore, their adolescent population appeared to be consuming fewer servings of fruits and vegetables than adults.

Inadequate nutrient intake is not the only concern in this population. The National Health and Nutrition Examination Surveys (NHANES) in the United States are showing increasing prevalence of overweight in adults and adolescents during the last 15 years (Cavadini, et al., 2000). In the Mediterranean nation of Cyprus, 16.9% of male and 13.1% of female adolescents are classified as overweight and 10.3% and 9.1%, respectively, are obese according to NHANES references (Savva, et al., 2002). It should be mentioned that the researchers from the above study also found that the most significant association for adolescent obesity was parental obesity. The increased rates of overweight and obesity have the potential for severe repercussions later in life. For example, being overweight during adolescence is associated with an increased risk of hypertension and adult-onset diabetes during adolescence as well as an increased risk for being overweight as an adult (Videon & Manning., 2003). Munoz, et al., (1997) suggest that dietary patterns during adolescence may increase risk for cardiovascular disease as well as some forms of cancers later in life.
When data from 2002 on weight and cholesterol levels in 12 year old Cretan boys were compared with their peers from 1982, the results showed significant increases in all measures (Magkos, et al., 2005). The researchers found an 8.4% increase in BMI, 63% increase in overweight and 202% increase in obesity. Additionally, total serum cholesterol increased by 3.6%, while high-density lipoprotein (HDL) levels decreased by 24.9% and low-density lipoprotein (LDL) and triglyceride (TG) levels increased by 25.3% and 19.4% respectively, with a dramatic increase in LDL/HDL ratio of 603%. These results indicate an increased risk for cardiovascular morbidity and mortality in the near future for this population of children. Unfortunately, morbidity has already become an issue as demonstrated by Menghetti, et al., (2004) who found that 30% of obese eleven to fourteen year olds have increased levels of blood pressure. This is important as blood lipid levels track through adulthood suggesting that high blood lipid in childhood will result in high blood lipid levels later in life (Mellies, et al., 1985). Since eating habits develop during adolescence and may continue through adulthood, it is important for healthy eating practices to be established early (Story, et al., 1986).

**Nutrition Transition**

In spite of the large amount of information supporting the MD, not all countries bordering the Mediterranean have chosen to preserve these distinctive dietary patterns. Even Greece, the country renowned for its low rates of cardiovascular disease and long life span, has been shifting away from its traditional dietary patterns to adopt a more westernized lifestyle (Klimis, et al., 2000; Yannakoulia, et al., 2004a). Since the end of World War II, chronic disease rates and cancer have been steadily increasing in Greece.
Even more interesting is the finding that as rates of cerebrovascular disease and ischemic heart disease appear to be decreasing in many European countries including Finland, The Netherlands, and Italy, trends in Greece are increasing (Trichopoulou & Efstathiadis, 1989).

Obesity levels and rates of chronic disease are on the rise (Trichopoulou & Efstathiadis, 1989) secondary to a decrease in energy expenditure and the increased consumption of low nutrient density foods, including soft drinks, candy, and sweets, increased refining of grains, and higher percentages of meats. Kafatos, et al., (1997) reported that there was a 24.5% increase in saturated fatty acid content in the adipose tissues of Cretan male adults. This increase was associated with a 4% decrease in monounsaturated fatty acid and a 30% decrease in the polyunsaturated fatty acid content. They indicated that this was most likely secondary to the increased consumption of meat, fish, and cheese and the decreased consumption of breads, potatoes, fruits, eggs, milk, and olive oil. These changes have resulted in a reduction of antioxidants, vitamins, and fiber in the diet and are accompanied by increased proportions of saturated fatty acids (Kafatos, et al., 1997). The authors also commented that the younger population appeared to more readily abandon their traditional Mediterranean dietary patterns and as a result had the most compromised intakes (Serra-Majem, et al., 2004). Nutrient content was evaluated in an adolescent population in the HNA study and was determined that the majority of the population was not meeting RDA’s for many nutrients and antioxidants (Klimis, et al., 2001; Papoutsakis, et al., 2001). The question is raised as to whether the MD and its protective benefits will be able to endure in the future.
Currently, greater than 50% of women over 55 years of age in Greece are obese with a BMI greater than 30 and the approximately 50% of the adult population in Greece is either overweight or obese (Ferro-Luzzi, et al., 2002). The above author suspects that this prevalence of obesity in older women is higher than anywhere in the world except the Pacific Islands. Klimis, et al., (2000) found that greater than 50% of male adults on an Aegean island in Lesvos had an increased risk for cardiovascular disease, based on their blood lipid and lipoprotein profiles. Normal lipid levels were found in the HNA study adolescent population (Klimis, et al., 1999); however, their shift in diet from the traditional healthful MD to a diet which may promote obesity and chronic disease, such as the “Nutrition Transition”, could pose health problems in the future.

**Stages of Nutrition Transition.**

In a review on the Nutrition Transition, Popkin (2002) explains that there are five patterns of food intake world-wide. The first is the “Collecting Food” stage and refers to the hunter-gatherer populations. It is typically high in grains and plant foods and is low in fat—particularly saturated fat—with very high activity levels. This pattern is associated with very low rates of obesity. The next pattern deals with “Famine”, during which the diet lacks variety and animal products are rarely consumed, but there is no relative change in physical activity from the “Collecting Food” pattern. In the pattern of “Receding Famine”, fruits, vegetables, and animal-product consumption increases while staple foods such as whole grains lose significance. Activity in this stage begins to shift toward leisure and inactivity. The fourth pattern is of the most concern and involves dramatic increases in “Nutrition-Related Non-Communicable Diseases” Pattern (NRNCP). It is characterized by a diet high in total fat, cholesterol, sugar, and other
refined carbohydrates and is low in polyunsaturated fatty acids and fiber. Accompanied with an increased sedentary lifestyle, this pattern is associated with obesity and its co-morbidities. This lifestyle is typical of most upper-income societies including the United States and much of Europe. The last pattern identified by Popkin (2002) is that of “Behavioral Change”. As more attention is brought on the effects of diet on health, many have re-formatted their diets to the one similar to the “Collecting Food” pattern in an effort to prevent or delay the health effects of chronic diseases.

**Causal factors involved in the Nutrition Transition.**

Nutrition Transition relates to globalization, urbanization, and the introduction of “new” and affordable food items into the market with more innovative methods in which to market them. Therefore, access to mass media and marketing ploys have led to increased amounts of “new” food consumption which in turn resulted in dietary changes (Pekka, et al., 2004). Diet changes are evident in the differences in the average diets between urban and rural populations. Urban populations tend to consume more milled and polished grains, animal products, sugar, ready-prepared and processed foods and generally have a higher fat content in their diet. Consumption of meats, eggs, and dairy products also increase in urban populations, while staple foods decrease (Pekka, et al., 2004).

With globalization comes a greater variety of foods and new ways in which to eat them (Pekka, et al., 2004) that Holmboe-Ottesen (2000) calls “McDonaldization”. Products with added sugars, such as sodas and other sweetened beverages, low-nutrient snacks, and high saturated fat, fast-food items produced by multinational companies are
sweeping the world. Greater income in populations where the Nutrition Transition is occurring also allows for the increased purchase of the above foods and services. Unfortunately, with the introduction of the above food products and lifestyles, fewer families are making time for meals together (Holmboe-Ottesen, 2000) and, therefore, greater percentages of the population are consuming “new” foods in place of traditional meals. Popkin (1996) comments that the transition from staple foods to fast foods (“new” foods) is also partially due to the introduction of women into the workforce. Without a person at home, there is less time to prepare foods, which results in larger amounts of fast-foods being consumed and fewer family meals.

**Nutrition Transition and adolescent diets.**

Many studies have been conducted to evaluate nutritional adequacy in adults and adolescents (Frank, et al., 1992; Kafatos, et al., 200; Cavadini, et al., 2000). Most studies focus on nutrient intake rather than food group-based consumption and food patterns. However, food-based dietary guidelines are more easily understood by the population than nutrients or food weights. The following is a compilation of studies conducted with adolescents to determine whether their nutritional habits are meeting recommendations.

In 2000, Cavadini, et al., evaluated intake trends from NHANES data to analyze changes in food and nutrient intakes. Despite an apparent increase in vegetable consumption between 1965 and 1996, it was noted that white potatoes and French fries were included in the category which accounted for half the intake of vegetables in 1996 compared with one-third in 1965. Grain intake also increased, but this increase was secondary to the increased consumption of high-fat combination meals such as pizza and
macaroni and cheese. Overall, the authors saw a decrease in raw fruit, non-potato
sources of vegetables, and calcium rich dairy sources.

As part of the Bogalusa Study (Nicklas, et al., 1989), researchers evaluated some
food habits of adolescents using a food frequency questionnaire. While 19% of
adolescents between the ages of 12 and 17 reported consuming one or more servings of
whole milk per day, 58% reported never having low-fat milk and only 5% consumed low
fat milk once or more per day. Fish and nuts were most often reported as “not eaten last
week”, egg consumption averaged approximately one per week, and they consumed only
low amounts of cheese (Frank, et al., 1992). As was found by most studies, males
consumed significantly more eggs, whole milk, low-fat milk, grains, poultry, and red
meat than females, while females tended to consume more fruits and vegetables (Nicklas,

In 2004, Serra-Majem, et al., studied MD adherence in Spanish children and
adolescents using a sixteen question survey with a maximum of twelve points. KIDMED
evaluated compliance to the MD and discovered that greater than 50% of the
approximately 3800 participants were found to have only very low to moderate
adherence.

Little research to date has been conducted in Greece to evaluate eating habits or
and status in a cohort of 13 and 14 year olds in Crete. They reported that the mean
vitamin E intake in these adolescents exceeded the recommended value of 10mg of alpha
tocopherol per day (average of 11.1 mg). They attributed the high vitamin E levels to the
high level of olive oil consumption in this group: 70.7 ± 15.4 grams per day. Roma-
Giannikou (1996) found that Greek children consumed twice the Population Reference Intake (PRI) for protein, a higher intake of disaccharides (from milk), and a higher percent of energy from fat than other countries.

As Kafatos, et al., (2000) discuss, 46% of the foods Greek children consume were industrially produced foods or drinks, 20% are fried foods, 26% are boiled or roasted foods and only 15% are raw fruits and vegetables. Their diets are high in saturated fat (with a 100% increase since the 1960’s), tran-saturated fat, and cholesterol and low in fiber, potassium, and folic acid. Hassapidou and Fotiadou (2001) add that while energy intake of Greek adolescents was adequate, levels of iron, vitamin A, folate and zinc did not meet recommendations, which was most likely secondary to a poor diet.

Data from the HNA study demonstrated the daily energy and macronutrient composition of the our population (Yannakoulia, et al., 2004b). While kcalorie consumption was significantly greater in males than females, the macronutrient composition was not different between genders. The kcalorie distribution among macronutrients are presented in Table 1.

Table 1. Average daily energy and macronutrient composition of males and females.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Males (n = 53)</th>
<th>Females (n = 60)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average daily energy (kcal)</td>
<td>2908</td>
<td>1866**</td>
</tr>
<tr>
<td>Carbohydrate (% of energy)</td>
<td>44.8</td>
<td>44.2</td>
</tr>
<tr>
<td>Protein (% of energy)</td>
<td>15.4</td>
<td>14.7</td>
</tr>
<tr>
<td>Fat (% of energy)</td>
<td>39.8</td>
<td>40.7</td>
</tr>
</tbody>
</table>

**Statistically significant at p ≤0.05

*Adapted from Yannakoulia, et al., 2004b
Additional results from the HNA study by Kelmis-Zacas, et al., (2001) and Papoutsakis-Tsarouhas, et al., (2001), found that while female adolescent consumption of vitamin C and B6 exceeded the Recommended Dietary Allowances (RDA’s), intake of calcium, iron, selenium, manganese, magnesium, vitamins E and D, as well as thiamin, niacin, and folic acid did not meet RDA recommendations. Males, on the other hand, met most of the RDA’s except vitamin D, zinc, and magnesium.

Disordered eating may also be an issue in the adolescent population. The HNA study revealed that greater than 20% of females and 7% of males demonstrated disordered eating attitudes (Yannakoulia, et al., 2004b). The authors mentioned that carbohydrate-phobia has become popular in adolescents from Greece, particularly females.

Using a survey, Yannakoulia, et al., (2004a) reported on the eating habits of younger adolescents (12.5 – 15.5 years). They found strong positive correlations between television viewing and consumption of sodas, cakes and sweets, and chips. They also found that as age increased from 11.5 years to 15.5 years, fruit and vegetable consumption decreased, sodas, sweets and pastries increased, grains decreased and milk consumption decreased in females. However, it should be noted that these younger adolescents most likely do not have as much freedom over their nutrition as older adolescents, which comes with having a job, later curfews, and more money.

As previously discussed, fast food items have become an important part of the typical adolescent diet. Fast foods are defined as quick and affordable alternatives to home cooking (Webner, 2003). They are typically high in calories, fat, saturated fat, sugar, and salt and are rapidly integrating themselves into the lifestyles of adolescents (Mahna, et al., 2004). Mahna, et al., (2004) demonstrated that 65% of an Indian
adolescent cohort reported consuming pizza, burgers, ice cream, soft drinks, French fries, and sandwiches in the place of normal meals. Of the participants, 16% were classified as 'low fast food eaters' (<10% kcals), 63% were classified as 'moderate fast food eaters' (10-30% kcals) and 21% were classified as 'high fast food eaters' (>30%) – which was also associated with a high total daily calorie intake.

Since sweetened beverages are frequently consumed as well and may be replacing more important fluids such as milk, 100% juices, and water, while also contributing a substantial amount of calories to the diet, many studies were found that discussed these changes in children and adolescents (Ballew, et al., 2000; Cavadini, et al., 2000; Rampersaud, et al., 2003). According to the data from the Continuing Survey of Food Intakes by Individuals (CSFII), U.S. adolescents between the ages of 14 and 18 are consuming approximately 18 ounces of soft drinks, only 7.8 ounces of milk and 3.7 ounces of 100% fruit juice per day (note that soda intake is greater than double that of milk intake) (Rampersaud, et al., 2003). Non-diet soft drink intake has been positively associated with energy intake in children which may be contributing to the increased frequency of obesity and its co-morbidities observed during youth. Ballew, et al., (2000) found that while milk consumption among adolescents in the U.S. decreased 25% from 1977 to 1994, soft drink consumption increased by 41%. Similar results were seen by Cavadini, et al., (2000) and Bowman (2002) who also added that a significant negative correlation was apparent between soft drinks and milk in adolescents. Therefore, the highest consumers of soft drinks had the lowest consumption of milk. The replacement of milk is disturbing since milk and 100% juices are some of the major sources of vitamins A, C, D, and B, calcium, magnesium, and phosphorus. Although both Bowman
(2002) and Harnack, et al., (1999) state that a decrease in milk intake is typical during adolescence. Those who did not drink milk had inadequate intakes of vitamins and minerals (Guenther, 1986). This replacement of nutrient-dense beverages with sweetened beverages signals a need for intervention during this age period.

In reference to patterns of beverage consumption, Guenther (1986) reported that coffee and juice were most likely to be consumed during the breakfast period. Milk was less likely to be consumed at snacks than at meals and boys appeared to drink more milk at any time period, but most often during breakfast. Soft drink consumption did not appear to correlate with any specific time period, but rather was dispersed throughout the entire day. Although a slightly larger percent of females drank soft drinks, males consumed much larger quantities. Only 2% of girls and 3% of boys reported consuming alcohol and the intake of the male population was almost three times (364 g) that of the females (130 grams) (Guenther, 1986).

Studies have demonstrated inconsistency between adolescents’ nutritional knowledge and its translation into making healthful food choices. Although teenagers acknowledged some poor food habits such as skipping meals, unbalanced meal composition, and excessive snacking; they blamed lack of time, discipline, and a sense of urgency as barriers to altering these dietary behaviors (Lifshitz, et al., 1993).

Olsen, et al., (1984) surveyed adolescents’ attitudes toward their diets. Although sixty percent of the group believed they did not eat as they should, 82% indicated that they should eat less sweets, and 43% believed they should avoid “junk” foods, none understood the connection between poor dietary habits and future risk of chronic disease. Some adolescents show basic understanding between “good” and “bad” foods, but cannot
correlate these behaviors with potential health risks, nor do they feel the urgency to worry about such issues at their age. These studies demonstrate the need for nutrition education to be focused toward their "here and now" attitudes of adolescents (Court, 1988).

Interventional studies using the MD recommendations have proven to be successful and offer hope to meeting the needs of this group of consumers. The Child and Adolescent Trial for Cardiovascular Health study (CATCH) measured differences in total fat, saturated fat, and sodium intake between 3rd through 5th grade in participating schools after nutritional intervention (Lytle, et al., 1996). Their results showed a 2.4% decrease in total kcals from fat (compared to 0.4% in control), a 1.2% decrease in kcals from saturated fat (compared to 0.3% in control), as well as a significant drop in sodium per 1,000 kcaldies (-38mg compared to +76mg/1,000kcals).

Manios, et al., (2002) studied the effects of nutrition and physical activity education over a six year period in Greek children and found significantly lower BMI, body weight, and lower concentrations of LDL cholesterol and LDL:HDL ratios as well as increased muscle mass, length of reported physical activity per week and decreased saturated fat and total fat intake compared with the control group.

In Crete, Kafatos, et al., (2004) researched the effectiveness and child response to an educational course on the MD. They determined that changes in pupil knowledge and understanding of the course material were related to teacher enthusiasm. The researchers concluded that attempts to introduce the principles of a MD to children through nutrition education require innovative, enthusiastic and highly motivated teachers. Their results showed that education can affect the lifestyle choices of adolescents and positively affect their health in the future (Kafatos, et al., 2004).
Chapter 3

METHODS AND MATERIALS

Harokopio Nutrition Assessment Study

The Harokopio Nutrition Assessment Study (HNA) was conducted in May 1998 by a team of faculty at the Harokopio University in Athens, Greece. The team included Dr. Antonia Leda Matalas, Dr. Michael Passos, Dr. Evangellos Polychronopoulos, Dr. Mary Yiannakoulia, Dr. Nikos Yiannakouris, and was directed by Dr. Dorothy Klimis-Zacas.

Population.

A convenience sample of one hundred twenty students from two high-schools in Nea Smirni, Athens, Greece, were recruited to participate in the Harokopio Nutrition Assessment Study (HNA). Age of the participants ranged from 14-25 years. Informed consent was obtained for each student as well as a parent or guardian. Data for the study was collected during May of 1998. Approval was granted by the Ethics Committee of Harokopio University and the Greek Ministry of Education to initiate the procedures of the study. Anthropometric and body composition data were collected according to the standard procedures of the World Health Organization (1998). Each participant completed a self-administered three-day food diary, a Food Frequency Questionnaire, an Eating Attitudes Test (EAT-26), and a questionnaire on physical activity and demographic information. Fasting blood samples were also taken for various biochemical assays.
Questionnaires

All instruments and questionnaires were designed and validated by Dr. Dorothy Klimis-Zacas, Dr. Antonia Matalas, and Dr. Mary Yiannakoulia.

Three day food diary

Students received a food journal in which they were asked to record all food items ingested in a consecutive three day period: two weekdays and a weekend day. Refer to Appendix B to view sample pages from the food diary. Before implementation of the study, all participants were required to attend a one hour educational training session presented by a Dietitian, on proper techniques for accurate recording. The students were asked to record the type and brand of food or beverage, the amount consumed using household measuring utensils, and the approximate time of each meal or snack. In addition to this, they were also asked to record who prepared the food, where the food was eaten, who the food was eaten with, and what they were doing while eating the food. At the conclusion of the three days, the questionnaires were returned to member of the research team who re-evaluated the diary with the student to better clarify amounts or improperly explained food items.

Food Frequency Questionnaire

Each participant completed a validated FFQ (Gnardellis, et al., 1995) of traditional Greek foods. Along with food models and measuring utensils, pictures from the FFQ were used for clarification of portion sizes by the Dietitian as the 3-day food diaries were returned. Sample pictures from the FFQ may be viewed in Appendix C.
Demographic data

Information regarding rate of physical activity, smoking and alcohol use was obtained from a self-administered questionnaire. Students were then categorized according to their responses. Rate of physical activity was categorized as sedentary, light, moderate, or vigorous (U.S. Department of Health and Human Services, 1988). Sedentary was defined as <1 day of stretching and strengthening exercise, no walking or bicycling, none or >10 minutes participation in gym class, no participation in athletic teams. Light activity was defined as one day of at least 20 minutes of sweating and hard breathing, 1-4 days of stretching and strengthening exercises, 1-2 days of walking or bicycling (aerobics), gym class participation 1-2 days <10 minutes, no participation in athletic teams. Moderate activity was distinguished as two days of >20 minutes of sweating and hard breathing, >5 days of stretching and strengthening, greater than three days of aerobics, gym class participation for 3-4 days for 10 to 20 minutes, no participation in athletic teams. Vigorous activity was defined as >3 days of sweat and hard breathing exercise, >5 days of aerobics, >5 days in gym for more than 20 minutes, or participation in athletic teams. Tobacco use was classified as none, light (<½ pack per day), moderate (>½ pack per day and <1 and ½ packs per day), or heavy (>1 and ½ packs per day). Alcohol consumption was categorized into groups of none, occasional (<2 drinks per week), or heavy (>10 drinks per week) (U.S. Department of Health and Human Services, 1988).
**Anthropometric measurements.**

Height was measured using a wall-mounted stadiometer to the nearest 0.5 cm and weight was measured using a portable spring scale to the nearest 0.5 kg. Body Mass Index (BMI) was then calculated (Cole, et al., 2000). Skinfold thickness measurements were taken from the triceps, biceps, subscapular and suprailiac sites using a Lange skinfold caliper (Cambridge Scientific Instruments, Cambridge, MA, USA) to a precision of 0.2 mm-measurements as described by Durnin and Womersley (1974). Measurements were taken twice and averaged. Body composition was also measured by the bioelectrical impedance analysis (BIA) method as described by Lukaski, et al., (1985) using a single frequency (50 kHz), four-terminal impedance plethysmograph (Model 101, RJL-Systems, Mt. Clemens, MI, USA). Fat-Free mass (FFM) and percent Fat Mass (FM) were assessed using the prediction formulas developed by Deurenberg, et al., (1991) according to age and gender. All measurements were taken by a single, trained member of the research team. Participants of this study were classified as normal weight, overweight, or obese according to their BMI: females >25 as overweight and >30 as obese and males >25 as overweight and >28 as obese (Heunemann, et al., 1966).

**Population Instruments and Data Utilized for Present Thesis**

**Data translation and population.**

Once all data were collected original questionnaires were transported to the United States. With assistance from Dr. Kulea, the 3-day food diary data were translated to English for further evaluation and analysis. Of the 120 study participants, data from 113 (60 females and 53 males) were utilized to answer the objectives of this thesis.
Food groups and serving sizes.

Diary food data were divided into the groups listed in Table 2 according to the USDA Food Guide Pyramid (FGP) recommendations.

The Total Vegetables group was comprised of all vegetables and potatoes (French fries included). The Vegetable no potato group, excluded all potatoes and French fries, and the Vegetable no French fries excluded only French fries. Groups for potatoes (which did not include French fries) and French fries were also created.

Meats were separated into two classifications according to: 1) the fat content (lean, medium-fat, and high-fat), and 2) the source (red meat, poultry, and fish). The Total Meat group was composed of the individual totals from meats. Fat content of meats was evaluated using the Diabetic Exchange Lists for Meal Planning (American Diabetic Association, 1995). Fish, white meat chicken, and rabbit were examples of lean meats. Fried fish and chicken, burger, and most lamb products were classified as medium-fat meats. Sausages and bacon were examples of meats classified as high-fat meats. Red meats included all animal products such as beef, pork, deer, rabbit, and lamb. Poultry included all fowl such as chicken, turkey, and pheasant; and Fish incorporated all marine animals including squid, octopus, and fresh and salt-water fish. The Total Meat-substitutes group was calculated from nuts and seeds, legumes, and eggs. The Total Meat-products group was then calculated from the addition of the Total Meat group and the Total Meat-substitutes group.
Table 2. Food group categories from 3-day food diaries.

<table>
<thead>
<tr>
<th>Grains</th>
<th>Coffee</th>
<th>Sweetened beverages</th>
<th>Total sweets</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fruit</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vegetable no potato</td>
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<tr>
<td>Vegetable no French Fries</td>
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<td></td>
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<tr>
<td>Potatoes</td>
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<td></td>
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<tr>
<td>French Fries</td>
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<td><strong>Total Vegetables</strong></td>
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<td>Vegetable no potato</td>
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<td>Vegetable no French Fries</td>
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<td>Potatoes</td>
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<tr>
<td>French Fries</td>
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<tr>
<td><strong>Total meat</strong></td>
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<tr>
<td>Lean meat</td>
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<tr>
<td>Medium fat meat</td>
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<tr>
<td>High fat meat</td>
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<tr>
<td>Red meat</td>
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<td></td>
</tr>
<tr>
<td>Poultry</td>
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<td></td>
<td></td>
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<tr>
<td>Fish</td>
<td></td>
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<td></td>
</tr>
<tr>
<td><strong>Total meat-substitute</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Legumes</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nuts</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Eggs</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Total meat products</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cheese</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Milk</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chocolate milk</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1`Calculated from combined totals of Total meat and Total meat-substitutes.

2`Included milk from chocolate milk.
The Total Dairy group was calculated from the addition of the cheese, milk, and chocolate milk groups. Chocolate milk was separated from the milk group because it was felt that its consumption merited further evaluation. Yogurt was incorporated into the milk group and was not evaluated separately because its consumption was not found to be substantial in this population. Ice cream was also classified under the milk category (as well as under its own subcategory under Total Sweets).

The sweetened beverages group was mostly comprised of non-diet soft drinks, however, some drinks (including fruit drinks and lemonade) offered large amounts of sugar and were therefore incorporated into this group as well. The Total sweets group was calculated from the addition of the following groups: ice cream, chocolate, cakes, and cookies.

Fats were calculated as number of teaspoons from both reported use by the participants (ex: 1 teaspoon of butter and 1 slice bread) as well as from the breakdown of composite foods into their original components (refer to Appendix D). Total Fat (in teaspoons) was then calculated from the addition of margarine, mayonnaise, butter and oil. Comparisons of different oils could not be evaluated further due to lack of data.

Alcohol was separated into servings of liquor, wine, and beer. Total Alcohol was then calculated from the addition of these three subgroups.

Serving sizes were defined according to the USDA FGP recommendations (which are the same as the Mediterranean Diet Pyramid (MD) recommendations) and can be viewed in Table 3. Additional detailed food classifications can be found in Appendix D.
Table 3. Serving size classifications for food groups.

<table>
<thead>
<tr>
<th>Food Group</th>
<th>Serving size</th>
</tr>
</thead>
</table>
| 1 serving fruit          | • ½ c. cooked or chopped  
                           | • ¼ c. dried  
                           | • ¾ c. 100% juice  
                           | • 1 medium fruit      |
| 1 serving vegetable      | • ½ c. cooked  
                           | • 1 c. raw leafy vegetables  
                           | • ¼ c. vegetable juice |
| 1 serving grain          | • 1 slice bread  
                           | • 1 oz. ready-to-eat cereal  
                           | • ½ c. cooked rice or pasta  
                           | • Other grain products: pretzel, pizza crust, etc. that is equivalent to one slice bread (30 grams) |
| 1 serving dairy          | • 1 c. milk or yogurt  
                           | • 1 c. ice cream  
                           | • 2 oz. processed cheese  
                           | • 1.5 oz. natural cheese |
| 1 oz meat or meat        | • 1 oz. of meat  
                           | equivalent\(^1\)  
                           | • ¼ c. cooked legumes  
                           | • ½ oz. nuts  
                           | • 1 egg |
| 1 serving alcohol        | • 12 oz. beer  
                           | • 6 oz. wine  
                           | • 2 oz. liquor |

\(^1\)U.S. Department of Agriculture, 2005
\(^2\)1 servings was equivalent to 2-3 ounces, but to maintain consistency an average of 2.5 ounces was used to calculate ounces to servings.
As demonstrated in Table 3, one medium apple was equivalent to one serving of fruit, forty-five grams of unprocessed cheese (as determined by the product brand) was equivalent to one serving of cheese, and one cup of pasta was equivalent to two servings of grains. Complex food items including hamburgers and souvlaki (pita, meat, olive oil, French fries) were separated into basic components. Therefore, one small McDonald’s hamburger was classified as two grain servings and two ounces red meat as well as two ounces of medium-fat meat. As the previous example demonstrates, some foods were classified under more than one food group. As previously explained, meats were classified not only by fat content (lean, medium, and high fat), but also by source (fish, poultry, and red meat) and, of course, were included in the Total Meat group and Total Meat-products group. It is of interest to note that some combination foods were also classified as the whole food to evaluate average daily consumption. The above combinations included burgers, pizza, and cheesepie and are also explained further under Appendix D.

Restaurant portions in the Greek market are regulated to be of similar quantities (Hellenic Ministry of Health and Welfare, 1999) and were considered when evaluating the 3-day food diaries. Therefore, in a rough approximation, one serving of grains or vegetables consumed at a restaurant was equivalent to two standard servings.

**USDA Food Guide Pyramid and Mediterranean Diet Pyramid recommendations.**

The USDA FGP offers separate suggestions for males and females of varying ages and activity levels. For this sample, food-based guidelines were set according to recommendations from the USDA Food Pyramid website (www.mypyramid.gov) for
males and females according to their sex-specific average age and activity levels (as determined from demographic information). Table 4 lists the recommendations for both sexes.

Table 4. Sex and age specific USDA Food Guide Pyramid recommendations.

<table>
<thead>
<tr>
<th>Food Group</th>
<th>Daily Serving Recommendation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Males</td>
</tr>
<tr>
<td>Grains</td>
<td>10</td>
</tr>
<tr>
<td>Vegetables</td>
<td>5</td>
</tr>
<tr>
<td>Fruits</td>
<td>4</td>
</tr>
<tr>
<td>Dairy</td>
<td>3</td>
</tr>
<tr>
<td>Meat</td>
<td>2.8 (7oz)</td>
</tr>
<tr>
<td>Tsp Oil</td>
<td>8</td>
</tr>
</tbody>
</table>

Advisory Committee, 2005; U.S. Department of Agriculture, 2005

The MD offers general recommendations for the entire population. These recommendations may be viewed in Table 5 (and Appendix A). Since daily servings were required for comparison with study data, weekly and monthly recommendations were extrapolated to daily recommendations. For example, the MD recommendation is a limit of three servings of sweets, eggs, and potatoes per week. Therefore, three servings was divided by seven (the number of days in the week) and a daily recommendation of 0.43 servings was obtained. Suggested serving sizes were obtained from the Hellenic Ministry of Health and Welfare (1999) “Dietary guidelines for adults in Greece”. These recommendations were identical to those from the USDA FGP recommendations.
Table 5. Mediterranean Diet serving size recommendations\textsuperscript{1}.

<table>
<thead>
<tr>
<th>Food Group</th>
<th>Recommendations</th>
<th>Daily Serving</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grains</td>
<td>8</td>
<td>8</td>
</tr>
<tr>
<td>Vegetables</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>Fruits</td>
<td>3 Daily</td>
<td>3</td>
</tr>
<tr>
<td>Dairy</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Oil</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sweets</td>
<td>3 Main source of fat</td>
<td>0.43</td>
</tr>
<tr>
<td>Potato</td>
<td>3 Weekly</td>
<td>0.43</td>
</tr>
<tr>
<td>Eggs</td>
<td>3 Weekly</td>
<td>0.43</td>
</tr>
<tr>
<td>Fish</td>
<td>5 to 6 Monthly</td>
<td>0.79</td>
</tr>
<tr>
<td>Poultry</td>
<td>4 Monthly</td>
<td>0.57</td>
</tr>
<tr>
<td>Red Meat</td>
<td>4 Monthly</td>
<td>0.13</td>
</tr>
</tbody>
</table>

\textsuperscript{1}Adapted from the Hellenic Ministry of Health and Welfare article: Dietary guidelines for adults in Greece, 1999.
**Frequency of food consumption.**

Frequency of food consumption was assigned into seven periods of time and can be viewed in Table 6. Time periods were assigned after reviewing the data and analyzing periods of most frequent meal consumption. It was apparent from the raw data that the mid-day meal was most frequently consumed between noon and 4:00 pm and the evening meal appeared to be most frequently consumed between 8:00 and 11:00 pm with snacks between the two periods.

<table>
<thead>
<tr>
<th>Time assignment</th>
<th>Time period</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>6:00 - 8:59 am</td>
</tr>
<tr>
<td>2</td>
<td>9:00 - 11:59 am</td>
</tr>
<tr>
<td>3</td>
<td>12:00 - 3:59 pm</td>
</tr>
<tr>
<td>4</td>
<td>4:00 - 7:59 pm</td>
</tr>
<tr>
<td>5</td>
<td>8:00 - 10:59 pm</td>
</tr>
<tr>
<td>6</td>
<td>11:00 - 2:59 am</td>
</tr>
<tr>
<td>7</td>
<td>3:00 - 5:59 am</td>
</tr>
</tbody>
</table>

**Statistical analysis.**

The data collected for this study were analyzed using SPSS Data Editor (Student Version 12.00, 2003). Data were transformed into three-day averages and daily averages by time assignment. Groups in SPSS were labeled by food, time assignment (1-7), and
day (a, b, c), e.g.: the amount of grains that students reported consuming on the first day at
time five (8:00 pm to 10:59 pm) was assigned “grains5a” in SPSS.

A One-way ANOVA was calculated to assess consistency between food groups at
each time assignment across the three days. For example, grains consumed at time one
(6:00 am to 8:59 am) in day one, was compared with grains consumed for days two and
three during the same time. Results were used to assess the degree of consistency for
each food consumed at each of the seven time assignments. This information was used as
statistical justification for pooling of the three days at each time interval into single
measures.

Eating patterns (types of foods consumed and times during the day) of male and
female subjects were first identified following a descriptive analysis and then the Chi
Square tests for proportion were calculated to assess statistical significance. Independent
sample t-tests were calculated to compare means of averages between males and females
for all food groups. Single sample t-tests were calculated to compare food consumption
of adolescents to the recommendations of both the USDA FGP and the MD Pyramid.
Bivariate Pearson-product-moment correlation coefficients were calculated to analyze
associations between food items and demographic information. Finally, the data from
these findings were compared with research from other countries. A significance level of
p ≤0.05 was used for all statistical analyses.
Chapter 4

RESULTS

Demographic Characteristics of the Population

Subject characteristics are presented in Table 7. Out of one hundred and twenty adolescents from two high-schools in Nea Smirni, Athens, Greece, who participated in the nutritional assessment study, one hundred and thirteen (94%) were involved in answering the objectives of this study. Sixty (53%) of the subjects were female and 53 (47%) were male. Age of the participants ranged from 14-26 years with a mean of 17.6 ± 1.7 years with the majority (92.8%) falling between 15 and 19 years. There was no significant difference between mean ages for males and females. Refer to Figure 1 for the distribution curve. Both average Body Mass Index (BMI) and percent body fat were statistically significantly different between male and female adolescents at a p ≤ 0.01. BMI ranged from 15.4-35.9 with a mean of 22.3 for the total population and sex-specific means of 23.4 for males and 21.2 for females (Figure 2). Approximately 58% of the population fell within the normal range for BMI of 19-24.9, while 19% were classified as underweight (<19), 16% were overweight, and 2.7% were obese. Percent body fat ranged from 6.4-34.9% with a total population mean of 22.7% and sex-specific means of 17.1% for males and 27.6% for females. Figure 3 presents percent body fat distribution curves for males and females.
Table 7. Demographic characteristics of the adolescent population.

<table>
<thead>
<tr>
<th>Demographic</th>
<th>Males (n = 53)</th>
<th>Females (n = 60)</th>
<th>Total (n = 113)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>17.8 ± 1.8</td>
<td>17.5 ± 1.6</td>
<td>17.6 ± 1.7</td>
</tr>
<tr>
<td>BMI</td>
<td>23.4 ± 3.9</td>
<td>21.3 ± 3.1**</td>
<td>22.3 ± 3.6</td>
</tr>
<tr>
<td>Percent body fat</td>
<td>15.1 ± 5.0</td>
<td>25.1 ± 4.9**</td>
<td>22.7 ± 8.0</td>
</tr>
</tbody>
</table>

**Statistically significant at p ≤0.01.

Figure 1. Age of participants.
Figure 2. Body mass index distribution of male and female participants.

**Males**

- **Body Mass index**
- **Mean = 23.4**
- **Std. Dev = 3.84**
- **N = 53.00**

**Females**

- **Body Mass index**
- **Mean = 21.3**
- **Std. Dev = 3.10**
- **N = 60.00**
Figure 3. Percent body fat distribution of male and female participants.

**Males**

- Std. Dev = 5.04
- Mean = 15.1
- N = 53.00

**Females**

- Std. Dev = 4.90
- Mean = 25.1
- N = 60.00
Table 8 lists the lifestyle characteristics of this population. Two subjects did not complete this section and were excluded from the lifestyle characteristic portion of this study. Therefore, the following data includes the self-reported lifestyle characteristics of fifty-two males and fifty-nine females. Exercise habits were reported as sedentary, light, moderate, and vigorous daily activity. A majority of the population reported moderate to vigorous daily exercise (65.5%), while 28.3% and 6.2% reported only light activity levels or a sedentary lifestyle. While approximately 80% of the female population reported light to moderate activity, 70% of the male population reported participating in daily moderate to vigorous activity.

Smoking habits were reported as none, light, moderate, and heavy use. Greater than half (57.5%) of the population reported themselves as non-smokers, while 8.8% considered themselves light smokers, 26.5% were considered moderate smokers, and 7.1% as heavy smokers. Also, when comparing males and females, more females reported themselves as moderate smokers, but substantially more males reported themselves as heavy smokers.

Alcohol consumption was divided into none, occasional consumption, and heavy consumption. Greater than 90% of the population reported themselves as non-drinkers with only 6.2% and 3.6% reporting occasional and heavy alcohol consumption. Percent of population averages for reported alcohol consumption were very similar between males and females. For instance, while 5.8% and 7.7% of males reported heavy and occasional consumption, 1.7% and 5% of females reported the same use.
Table 8. Self-reported lifestyle characteristics of the adolescent population.

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Males (n=52)</th>
<th>Females (n=59)</th>
<th>Total (n=111)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exercise %</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sedentary¹</td>
<td>5.8</td>
<td>6.6</td>
<td>6.2</td>
</tr>
<tr>
<td>Light²</td>
<td>23.1</td>
<td>32.8</td>
<td>28.3</td>
</tr>
<tr>
<td>Moderate³</td>
<td>34.6</td>
<td>47.5</td>
<td>41.6</td>
</tr>
<tr>
<td>Vigorous⁴</td>
<td>36.5</td>
<td>13.1</td>
<td>23.9</td>
</tr>
</tbody>
</table>

¹Sedentary: <1 day of stretching and strengthening exercise, no walking or bicycling, none or <10 minutes participation in gym class, no participation in athletic teams.

²Light: 1 day of at least 20 minutes of sweating and hard breathing, 1-4 days of stretching and strengthening exercises, 1-2 days of walking or bicycling (aerobics) gym class participation 1-2 days less than 10 minutes, no participation in athletic teams.

³Moderate: 2 days of at least 20 minutes of sweating and hard breathing, greater than five days of stretching and strengthening, greater than three days of aerobics, gym class participation for 3-4 days for 10 to 20 minutes, no participation in athletic teams.

⁴Vigorous: >3 days of sweat and hard breathing exercise, >5 days of aerobics, >5 days in gym for more than 20 minutes, or participation in athletic teams.
Table 8. Continued.

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Males (n=52)</th>
<th>Females (n=59)</th>
<th>Total (n=111)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Smoking %</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>None</td>
<td>59.6</td>
<td>55.7</td>
<td>57.5</td>
</tr>
<tr>
<td>Light¹</td>
<td>7.7</td>
<td>9.8</td>
<td>8.8</td>
</tr>
<tr>
<td>Moderate²</td>
<td>19.2</td>
<td>32.8</td>
<td>26.5</td>
</tr>
<tr>
<td>Heavy³</td>
<td>13.5</td>
<td>1.6</td>
<td>7.1</td>
</tr>
<tr>
<td><strong>Drinking %</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>None</td>
<td>86.5</td>
<td>93.3</td>
<td>90.2</td>
</tr>
<tr>
<td>Occasional⁴</td>
<td>7.7</td>
<td>5</td>
<td>6.2</td>
</tr>
<tr>
<td>Heavy⁵</td>
<td>5.8</td>
<td>1.7</td>
<td>3.6</td>
</tr>
</tbody>
</table>

¹Light: < ½ pack per day  
²Moderate: > ½ pack per day and < 1 and ½ packs per day  
³Heavy: > 1 and ½ packs per day  
⁴Occasional: ≤ 2 drinks per week  
⁵Heavy: > 10 drinks per week
Food Group-based Average Servings of the Population

Three day average servings from all food groups (based on standards set a priori, Appendix C and pages 30-33 of the Methods section) for males and females are listed in Table 9. Males were found to consume significantly more of the following food groups than females (p ≤0.01): grains, total vegetables, vegetables without potatoes, vegetables without French fries, potatoes, French fries, total meat, medium meat, red meat, total dairy, cheese, gyro-souvlaki, pizza, and teaspoons oil. Males also consumed significantly more soda, milk, and chocolate milk than females (p ≤0.05). On the other hand, average amounts of fruit consumption, lean meats including poultry and fish, high fat meats, meat-substitutes including legumes and eggs, coffee, sweets, added fats (except oils), and alcohol were not significantly different between sexes (Table 9).
Table 9. Daily serving averages of food groups in males and females.

<table>
<thead>
<tr>
<th>Food Groups</th>
<th>Males</th>
<th>Females</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(n=53)</td>
<td>(n=60)</td>
<td>(n=113)</td>
</tr>
<tr>
<td>Grains(^1)</td>
<td>9.93 ± 5.89</td>
<td>5.22 ± 2.23**</td>
<td>7.43 ± 4.93</td>
</tr>
<tr>
<td>Fruit(^2)</td>
<td>0.39 ± 0.64</td>
<td>0.40 ± 0.64</td>
<td>0.40 ± 0.64</td>
</tr>
<tr>
<td>Juice(^3)</td>
<td>0.48 ± 0.82</td>
<td>0.53 ± 0.72</td>
<td>0.51 ± 0.76</td>
</tr>
<tr>
<td>Fruit and Juice</td>
<td>0.87 ± 1.11</td>
<td>0.94 ± 1.07</td>
<td>0.91 ± 1.08</td>
</tr>
<tr>
<td>Total Vegetables(^4)</td>
<td>3.14 ± 1.81</td>
<td>1.77 ± 0.95**</td>
<td>2.41 ± 1.57</td>
</tr>
<tr>
<td>Vegetable no potato</td>
<td>2.14 ± 1.59</td>
<td>1.20 ± 0.82**</td>
<td>1.54 ± 1.32</td>
</tr>
<tr>
<td>Vegetable no French fries</td>
<td>2.38 ± 1.57</td>
<td>1.32 ± 0.91**</td>
<td>1.81 ± 1.37</td>
</tr>
<tr>
<td>Potatoes(^5)</td>
<td>1.00 ± 0.89</td>
<td>0.57 ± 0.53**</td>
<td>0.77 ± 0.75</td>
</tr>
<tr>
<td>French Fries(^6)</td>
<td>0.76 ± 0.88</td>
<td>0.45 ± 0.48**</td>
<td>0.60 ± 0.71</td>
</tr>
</tbody>
</table>

**Statistically significant between males and females (p ≤0.01).
\(^1\)One serving is equivalent to 1 slice bread, 1 oz. ready-to-eat cereal, ½ c. cooked rice or pasta, or 1 oz of other grain product: pretzel, pizza crust, etc.
\(^2\)One serving is equivalent to ¼ c. cooked or chopped fruits, ¼ c. dried, ¼ c. 100% juice, or 1 medium fruit.
\(^3\)One serving is equivalent to ½ c. 100% juice.
\(^4\)Total vegetables is calculated from the addition of means of all vegetables including French fries and potatoes.
\(^5\)One serving is equivalent to 1 medium-sized potato.
\(^6\)One serving is equivalent to 10 French fries.

- Continued -
Table 9. Continued.

<table>
<thead>
<tr>
<th>Food Groups</th>
<th>Males (n=53)</th>
<th>Females (n=60)</th>
<th>Total (n=113)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Total meat</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lean meat</td>
<td>3.36 ± 1.85</td>
<td>1.97 ± 1.12**</td>
<td>2.62 ± 1.66</td>
</tr>
<tr>
<td>Medium meat</td>
<td>1.14 ± 0.93</td>
<td>0.86 ± 0.84</td>
<td>0.99 ± 0.89</td>
</tr>
<tr>
<td>High meat</td>
<td>2.07 ± 1.73</td>
<td>1.0 ± 0.80**</td>
<td>1.50 ± 1.42</td>
</tr>
<tr>
<td>Red meat</td>
<td>0.16 ± 0.28</td>
<td>0.11 ± 0.30</td>
<td>0.13 ± 0.29</td>
</tr>
<tr>
<td>Poultry</td>
<td>2.54 ± 1.79</td>
<td>1.24 ± 0.84**</td>
<td>1.85 ± 1.51</td>
</tr>
<tr>
<td>Fish</td>
<td>0.41 ± 0.73</td>
<td>0.41 ± 0.60</td>
<td>0.41 ± 0.66</td>
</tr>
<tr>
<td><strong>Total meat-substitute</strong></td>
<td>0.36 ± 0.67</td>
<td>0.30 ± 0.51</td>
<td>0.33 ± 0.59</td>
</tr>
<tr>
<td>Legumes</td>
<td>0.12 ± 0.27</td>
<td>0.13 ± 0.32</td>
<td>0.13 ± 0.30</td>
</tr>
<tr>
<td>Nuts</td>
<td>0.21 ± 0.75</td>
<td>0.08 ± 0.25</td>
<td>0.14 ± 0.55</td>
</tr>
<tr>
<td>Eggs</td>
<td>0.47 ± 0.46</td>
<td>0.36 ± 0.47</td>
<td>0.41 ± 0.47</td>
</tr>
<tr>
<td><strong>Total meat-products</strong></td>
<td>4.16 ± 2.23</td>
<td>2.54 ± 1.21</td>
<td>3.30 ± 1.93</td>
</tr>
</tbody>
</table>

**Statistically significant between males and females (p ≤0.01).
1 Total meat is calculated from the addition of lean, medium-fat, and high-fat meats and again from the addition of red meat, poultry, and fish.
2 One serving is equivalent to 2.5 oz. of fish, white meat chicken, veal, or rabbit.
3 One serving is equivalent to 2.5 oz. of fried meats, ground meats, most lamb or beef products unless specified as lean.
4 One serving is equivalent to 2.5 oz. of sausage or bacon.
5 One serving is equivalent to 2.5 oz. of any warm-blooded animal product including beef, lamb, pig, or deer.
6 One serving is equivalent to 2.5 oz. of any fowl product including chicken, duck, or game hen.
7 One serving is equivalent to 2.5 oz. of any marine animal including all fish, squid, or octopus.
8 Total meat-substitute is calculated from the addition of legumes, nuts, and eggs.
9 One serving is equivalent to ¼ c. cooked legumes.
10 One serving is equivalent to ½ oz. nuts.
11 One serving is equivalent to 1 egg.
12 Total meat products is calculated from the addition of total meat and total meat substitutes.
### Table 9. Continued.

<table>
<thead>
<tr>
<th>Food Groups</th>
<th>Males</th>
<th>Females</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(n=53)</td>
<td>(n=60)</td>
<td>(n=113)</td>
</tr>
<tr>
<td><strong>Total dairy</strong></td>
<td><strong>3.40 ± 2.36</strong></td>
<td><strong>2.23 ± 1.08</strong></td>
<td><strong>2.81 ± 1.87</strong></td>
</tr>
<tr>
<td>Cheese</td>
<td><strong>2.02 ± 1.58</strong></td>
<td><strong>1.36 ± 0.95</strong></td>
<td><strong>1.67 ± 1.32</strong></td>
</tr>
<tr>
<td>Milk</td>
<td><strong>1.37 ± 1.15</strong></td>
<td><strong>0.93 ± 0.73</strong></td>
<td><strong>1.13 ± 0.97</strong></td>
</tr>
<tr>
<td>Chocolate milk</td>
<td><strong>0.36 ± 0.73</strong></td>
<td><strong>0.15 ± 0.33</strong></td>
<td><strong>0.25 ± 0.56</strong></td>
</tr>
<tr>
<td>Coffee</td>
<td><strong>0.36 ± 0.55</strong></td>
<td><strong>0.56 ± 0.62</strong></td>
<td><strong>0.47 ± 0.59</strong></td>
</tr>
<tr>
<td><strong>Sweetened beverages</strong></td>
<td><strong>0.94 ± 1.21</strong></td>
<td><strong>0.56 ± 0.59</strong></td>
<td><strong>0.74 ± 0.95</strong></td>
</tr>
<tr>
<td><strong>Total alcohol</strong></td>
<td><strong>0.34 ± 0.80</strong></td>
<td><strong>0.27 ± 0.61</strong></td>
<td><strong>0.30 ± 0.71</strong></td>
</tr>
<tr>
<td>Liquor</td>
<td><strong>0.11 ± 0.51</strong></td>
<td><strong>0.10 ± 0.36</strong></td>
<td><strong>0.10 ± 0.43</strong></td>
</tr>
<tr>
<td>Wine</td>
<td><strong>0.11 ± 0.38</strong></td>
<td><strong>0.10 ± 0.40</strong></td>
<td><strong>0.10 ± 0.39</strong></td>
</tr>
<tr>
<td>Beer</td>
<td><strong>0.15 ± 0.46</strong></td>
<td><strong>0.07 ± 0.19</strong></td>
<td><strong>0.11 ± 0.34</strong></td>
</tr>
</tbody>
</table>

*Statistically significant between males and females (p ≤0.05).

**Statistically significant between males and females (p ≤0.01).

1Total dairy is calculated from the addition of means for cheese, milk, and chocolate milk.

2One serving is equivalent to 2 oz. processed or 1.5 oz. natural cheese.

3One serving is equivalent to 1 c. milk, chocolate milk, yogurt, or ice cream.

4One serving is equivalent to 1 c. chocolate milk. This was also classified under milk.

5One serving is equivalent to 1 reported intake of coffee, including Nescafe and café au lait.

6One serving is equivalent to 8 oz. of sweetened beverages, including soda and lemonade.

7Total alcohol is calculated from the addition of means for liquor, wine, and beer.

8One serving of liquor is equivalent to 2 oz. of any liquor beverage.

9One serving of wine is equivalent to 6 oz. of any wine beverage.

10One serving of beer is equivalent to 12 oz. of any beer beverage.

- Continued -
Table 9. Continued.

<table>
<thead>
<tr>
<th>Food Groups</th>
<th>Males (n=53)</th>
<th>Females (n=60)</th>
<th>Total (n=113)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total sweets(^1)</td>
<td>2.28 ± 1.94</td>
<td>1.68 ± 1.37</td>
<td>1.96 ± 1.68</td>
</tr>
<tr>
<td>Ice cream(^2)</td>
<td>0.42 ± 0.63</td>
<td>0.46 ± 0.53</td>
<td>0.44 ± 0.58</td>
</tr>
<tr>
<td>Cake(^3)</td>
<td>0.42 ± 0.17</td>
<td>0.14 ± 0.38</td>
<td>0.19 ± 0.40</td>
</tr>
<tr>
<td>Chocolate(^4)</td>
<td>0.16 ± 0.46</td>
<td>0.22 ± 0.48</td>
<td>0.19 ± 0.47</td>
</tr>
<tr>
<td>Cookies(^5)</td>
<td>0.52 ± 1.14</td>
<td>0.29 ± 0.64</td>
<td>0.40 ± 0.91</td>
</tr>
</tbody>
</table>

**Other**\(^6\)

<table>
<thead>
<tr>
<th>Food Groups</th>
<th>Males (n=53)</th>
<th>Females (n=60)</th>
<th>Total (n=113)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Croissant</td>
<td>0.16 ± 0.30</td>
<td>0.08 ± 0.17</td>
<td>0.12 ± 0.24</td>
</tr>
<tr>
<td>Chips</td>
<td>0.07 ± 0.19</td>
<td>0.09 ± 0.19</td>
<td>0.08 ± 0.19</td>
</tr>
<tr>
<td>Gyro-souvlaki</td>
<td>0.42 ± 0.63</td>
<td>0.11 ± 0.25**</td>
<td>0.26 ± 0.49</td>
</tr>
<tr>
<td>Ham/cheese burger</td>
<td>0.47 ± 0.95</td>
<td>0.22 ± 0.38</td>
<td>0.34 ± 0.71</td>
</tr>
<tr>
<td>Pizza</td>
<td>0.61 ± 1.27</td>
<td>0.12 ± 0.40**</td>
<td>0.35 ± 0.95</td>
</tr>
<tr>
<td>Cheese pie</td>
<td>0.32 ± 0.45</td>
<td>0.24 ± 0.41</td>
<td>0.28 ± 0.43</td>
</tr>
</tbody>
</table>

**Fats**\(^7\)

<table>
<thead>
<tr>
<th>Food Groups</th>
<th>Males (n=53)</th>
<th>Females (n=60)</th>
<th>Total (n=113)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Margarine (tsp)</td>
<td>0.53 ± 1.72</td>
<td>0.14 ± 0.38</td>
<td>0.32 ± 1.22</td>
</tr>
<tr>
<td>Butter (tsp)</td>
<td>4.68 ± 4.04</td>
<td>3.34 ± 3.36</td>
<td>3.97 ± 3.74</td>
</tr>
<tr>
<td>Oil (tsp)</td>
<td>13.76 ± 6.43</td>
<td>8.60 ± 4.89**</td>
<td>11.02 ± 6.20</td>
</tr>
<tr>
<td>Mayonnaise (tsp)</td>
<td>0.25 ± 0.83</td>
<td>0.16 ± 0.46</td>
<td>0.20 ± 0.66</td>
</tr>
</tbody>
</table>

\(^{**}\)Statistically significant between males and females (p ≤0.01).
\(^{1}\)Total sweets is calculated from the addition of means for ice cream, cake, chocolate, and cookies.
\(^{2}\)One serving is equivalent to a ½ c. of ice cream.
\(^{3}\)One serving is equivalent to a 2" by 2" portion of cake.
\(^{4}\)One serving is equivalent to 1 average-sized candy bar.
\(^{5}\)One serving is equivalent to 2 cookies.
\(^{6}\)Other foods are evaluated as whole foods according to reported number of servings. For example: 1 bag of chips is equivalent to 1 chips and 1 slice of pizza was equivalent to 1 pizza, etc.
\(^{7}\)One serving of fat is equivalent to 1 tsp. These are obtained from reported use as well as from recipe breakdown of commonly consumed foods.
Comparisons of Food Group Average Servings to the USDA Food Guide Pyramid

Recommendations

Three day averages for males and females in comparison to recommendations from the USDA Food Guide Pyramid (FGP) (Advisory Committee, 2005) are listed in Table 10. Figure 4 presents this data graphically.

Based on mean intake, males met the recommended servings of grains, but did not meet recommendations for fruits or vegetables and exceeded the total meat products recommendation. Even when juice and French fries were added to the fruit and vegetable categories, they still did not meet recommendations by 3.13 servings of fruits and 1.86 servings of vegetables. Similar results for fruits and vegetables were seen in female adolescents. When fruit juice and French fries were counted under the fruit and vegetable categories, they still did not meet minimum recommendations for their sex with less than 1/3 of the recommendation for fruit and less than 1/2 the recommendation for vegetables. Females did not meet the recommended dairy servings, but did not greatly exceed total meat recommendations. Also, average oil intake was significantly greater (p ≤0.01) in both males and females than the USDA FGP recommendation (Table 10).
Table 10. Comparison of average food group servings of males and females to the USDA Food Guide Pyramid recommendations.

<table>
<thead>
<tr>
<th>Food Group</th>
<th>Males (n = 53)</th>
<th>USDA FGP&lt;sup&gt;a&lt;/sup&gt;</th>
<th>Females (n = 60)</th>
<th>USDA FGP&lt;sup&gt;a&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grains</td>
<td>9.93 ± 5.89</td>
<td>10</td>
<td>5.22 ± 2.23</td>
<td>6</td>
</tr>
<tr>
<td>Fruits</td>
<td>0.39 ± 0.64**</td>
<td>4</td>
<td>0.40 ± 0.64**</td>
<td>3</td>
</tr>
<tr>
<td>Fruit and juice</td>
<td>0.87 ± 1.11**</td>
<td>4</td>
<td>0.94 ± 1.07**</td>
<td>3</td>
</tr>
<tr>
<td>Vegetables</td>
<td>3.14 ± 1.81**</td>
<td>5</td>
<td>1.77 ± 0.95**</td>
<td>4</td>
</tr>
<tr>
<td>Vegetables no fries</td>
<td>2.38 ± 1.57**</td>
<td>5</td>
<td>1.32 ± 0.91**</td>
<td>4</td>
</tr>
<tr>
<td>Dairy products</td>
<td>3.40 ± 2.36</td>
<td>3</td>
<td>2.29 ± 1.08**</td>
<td>3</td>
</tr>
<tr>
<td>Total meat-products</td>
<td>4.16 ± 2.23**</td>
<td>2.8</td>
<td>2.54 ± 1.21</td>
<td>2.2</td>
</tr>
<tr>
<td>Oils (teaspoons)</td>
<td>13.76 ± 6.43**</td>
<td>8&lt;sup&gt;b&lt;/sup&gt;</td>
<td>8.60 ± 4.89**</td>
<td>6&lt;sup&gt;c&lt;/sup&gt;</td>
</tr>
</tbody>
</table>

**Significantly different than recommendation (p ≤ 0.01).

<sup>a</sup>FGP: Food Guide Pyramid

<sup>b</sup>Recommendations for 18 year old males with activity of 30-60 minutes per day.

(USDA, 2005)

<sup>c</sup>Recommendations for 17 year old females with activity of 30-60 minutes per day.

(USDA, 2005)
Figure 4. Average daily food group servings for male and female adolescents compared with recommendations from the USDA Food Guide Pyramid.

M-FGP: USDA recommendations for males
F-FGP: USDA recommendations for females.
**Comparisons of Food Group Average Servings to the Mediterranean Diet Pyramid**

**Recommendations**

Comparisons between male and female food group averages versus recommendations from the MD Pyramid are listed in Table 11. Figure 5 presents these data graphically. Unlike the USDA FGP recommendations, the Mediterranean Diet Pyramid (MD) does not have different serving amounts according to sex. Thus, weekly and monthly recommendations for meats, sweets, eggs, and potatoes were extrapolated into daily recommendations for comparison against average daily consumption (page 35 of the Methods section). Neither males nor females met the recommendation of three daily fruits, nor did they consume the six servings of vegetables recommended by the MD Pyramid. Both males and females exceeded the recommendations for dairy and red meat. In fact, males consumed almost twenty times and females approximately fourteen times the recommended servings for red meat. However, both consumed significantly less fish and poultry than specified by the MD. Actually, males and females consumed approximately 330% and 175% more red meat than fish and poultry combined. They also exceeded recommendations for sweets by almost five times.
Table 11. Comparison of average food group servings of males and females to the Mediterranean Diet Pyramid recommendations.

<table>
<thead>
<tr>
<th>Food Groups</th>
<th>Males (n=53)</th>
<th>Females (n=60)</th>
<th>Total (n=113)</th>
<th>MD&lt;sup&gt;a&lt;/sup&gt; Pyramid</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grains</td>
<td>9.93 ± 5.89**</td>
<td>5.22 ± 2.23**</td>
<td>7.43 ± 4.93</td>
<td>8</td>
</tr>
<tr>
<td>Fruit</td>
<td>0.39 ± 0.64**</td>
<td>0.40 ± 0.64**</td>
<td>0.40 ± 0.64**</td>
<td>3</td>
</tr>
<tr>
<td>Fruit and Juice</td>
<td>0.87 ± 1.11**</td>
<td>0.94 ± 1.07**</td>
<td>0.91 ± 1.08**</td>
<td>3</td>
</tr>
<tr>
<td>Veg no potato</td>
<td>2.14 ± 1.59**</td>
<td>1.20 ± 0.82**</td>
<td>1.64 ± 1.32**</td>
<td>6</td>
</tr>
<tr>
<td>Potato</td>
<td>1.00 ± 0.89**</td>
<td>0.57 ± 0.53</td>
<td>0.77 ± 0.75**</td>
<td>0.43</td>
</tr>
<tr>
<td>Sweets</td>
<td>2.28 ± 1.94**</td>
<td>1.68 ± 1.37**</td>
<td>1.96 ± 1.68**</td>
<td>0.43</td>
</tr>
<tr>
<td>Eggs</td>
<td>0.47 ± 0.46</td>
<td>0.36 ± 0.47*</td>
<td>0.41 ± 0.47</td>
<td>0.43</td>
</tr>
<tr>
<td>Dairy</td>
<td>3.40 ± 2.36**</td>
<td>2.29 ± 1.08**</td>
<td>2.81 ± 0.59**</td>
<td>2</td>
</tr>
<tr>
<td>Fish</td>
<td>0.36 ± 0.67**</td>
<td>0.30 ± 0.51**</td>
<td>0.33 ± 0.59**</td>
<td>0.79&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>Poultry</td>
<td>0.41 ± 0.73**</td>
<td>0.41 ± 0.60**</td>
<td>0.41 ± 0.66**</td>
<td>0.57&lt;sup&gt;c&lt;/sup&gt;</td>
</tr>
<tr>
<td>Red Meat</td>
<td>2.54 ± 1.70**</td>
<td>1.24 ± 0.84**</td>
<td>1.85 ± 1.51**</td>
<td>0.13&lt;sup&gt;d&lt;/sup&gt;</td>
</tr>
</tbody>
</table>

*Mean significantly different than recommendation (p ≤0.05).

**Mean significantly different than recommendation (p ≤0.01).

<sup>a</sup>MD: Mediterranean Diet

<sup>b</sup>Daily serving based on weekly recommendation of 5-6 servings.

<sup>c</sup>Daily serving based on weekly recommendation of 4 servings.

<sup>d</sup>Daily serving based on monthly recommendation of 4 servings.
Figure 5. Average daily food group servings for male and female adolescents compared with recommendations of the Mediterranean Diet Pyramid.
Percent of Males and Females Meeting the USDA Food Guide Pyramid and Mediterranean Diet Pyramid Recommendations

Percentages of the male and female population meeting the recommendations for the USDA FGP and the MD Pyramid are listed in Tables 12 and 13 respectively. None of the female adolescents from this population met the USDA FGP and MD Pyramid recommendations of three daily servings of fruits, nor did any meet the recommendation of four (USDA FGP) or six (MD Pyramid) daily servings of vegetables. In fact, 61.7% of females did not consume any fruits and 50% reported consuming less than 1.5 servings of vegetables daily during the three days of this study. Similar results are seen in the male population. Only 4.8% of males met the MD Pyramid recommendation of three servings of fruits, but only when juice was added to the group (range for fruit and juice from 0 – 4.55 servings). Otherwise, none of the participants met the three daily servings recommended for fruit alone or the four daily servings recommended by the USDA FGP (range for fruit alone, from 0 – 2.6 servings). In fact, 60.4% of the population did not report any fruit consumption during the three days of the study. Although 11.3% of males met the USDA FGP recommendation of five daily servings of vegetables, when French fries were separated from the vegetable group, only 5.7% met the recommendation. The MD Pyramid suggests six servings of vegetables which does not include potatoes and only 6.7% of males met this recommendation. Also, nearly 51% of the total population reported consuming less than 1.9 servings of vegetables per day.

Only 2.3% of females met the USDA recommendation of nine servings of grain, however, 16.7% met the MD Pyramid recommendation of eight servings. Also, 30% of females met the three-a-day recommendations for dairy and 53.3% met the MD Pyramid
Percent of Males and Females Meeting the USDA Food Guide Pyramid and Mediterranean Diet Pyramid Recommendations

Percentages of the male and female population meeting the recommendations for the USDA FGP and the MD Pyramid are listed in Tables 12 and 13 respectively. None of the female adolescents from this population met the USDA FGP and MD Pyramid recommendations of three daily servings of fruits, nor did any meet the recommendation of four (USDA FGP) or six (MD Pyramid) daily servings of vegetables. In fact, 61.7% of females did not consume any fruits and 50% reported consuming less than 1.5 servings of vegetables daily during the three days of this study. Similar results are seen in the male population. Only 4.8% of males met the MD Pyramid recommendation of three servings of fruits, but only when juice was added to the group (range for fruit and juice from 0 – 4.55 servings). Otherwise, none of the participants met the three daily servings recommended for fruit alone or the four daily servings recommended by the USDA FGP (range for fruit alone, from 0 – 2.6 servings). In fact, 60.4% of the population did not report any fruit consumption during the three days of the study. Although 11.3% of males met the USDA FGP recommendation of five daily servings of vegetables, when French fries were separated from the vegetable group, only 5.7% met the recommendation. The MD Pyramid suggests six servings of vegetables which does not include potatoes and only 6.7% of males met this recommendation. Also, nearly 51% of the total population reported consuming less than 1.9 servings of vegetables per day.

Only 2.3% of females met the USDA recommendation of nine servings of grain, however, 16.7% met the MD Pyramid recommendation of eight servings. Also, 30% of females met the three-a-day recommendations for dairy and 53.3% met the MD Pyramid
Table 12. Percentages of males and females meeting or exceeding USDA Food Guide Pyramid recommendations.

<table>
<thead>
<tr>
<th>Food Group</th>
<th>USDA FGP&lt;sup&gt;a&lt;/sup&gt;</th>
<th>Males (n = 53)</th>
<th>USDA FGP&lt;sup&gt;a&lt;/sup&gt;</th>
<th>Females (n = 60)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grains</td>
<td>10</td>
<td>30.2%</td>
<td>6</td>
<td>2.3%</td>
</tr>
<tr>
<td>Fruits</td>
<td>4</td>
<td>0.0%</td>
<td>3</td>
<td>0.0%</td>
</tr>
<tr>
<td>Fruits and juice</td>
<td>4</td>
<td>0.0%</td>
<td>3</td>
<td>0.0%</td>
</tr>
<tr>
<td>Total vegetables</td>
<td>5</td>
<td>11.3%</td>
<td>4</td>
<td>0.0%</td>
</tr>
<tr>
<td>Vegetables no fries</td>
<td>5</td>
<td>5.7%</td>
<td>4</td>
<td>0.0%</td>
</tr>
<tr>
<td>Dairy</td>
<td>3</td>
<td>50.9%</td>
<td>3</td>
<td>30.0%</td>
</tr>
<tr>
<td>Total meat products</td>
<td>2.8</td>
<td>60.4%</td>
<td>2.2</td>
<td>48.3%</td>
</tr>
</tbody>
</table>

<sup>a</sup>USDA Food Guide Pyramid.

Table 13. Percentages of males and females meeting or exceeding Mediterranean Diet Pyramid recommendations.

<table>
<thead>
<tr>
<th>Food Group</th>
<th>MD&lt;sup&gt;a&lt;/sup&gt; Servings</th>
<th>Males (n = 53)</th>
<th>Females (n = 60)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grains</td>
<td>8</td>
<td>49.1%</td>
<td>16.7%</td>
</tr>
<tr>
<td>Fruit</td>
<td>3</td>
<td>0.0%</td>
<td>0.0%</td>
</tr>
<tr>
<td>Fruit and Juice</td>
<td>3</td>
<td>4.8%</td>
<td>0.0%</td>
</tr>
<tr>
<td>Vegetables no potato</td>
<td>6</td>
<td>6.7%</td>
<td>0.0%</td>
</tr>
<tr>
<td>Potato</td>
<td>0.43</td>
<td>75.5%</td>
<td>53.3%</td>
</tr>
<tr>
<td>Sweets</td>
<td>0.43</td>
<td>54.7%</td>
<td>66.6%</td>
</tr>
<tr>
<td>Eggs</td>
<td>0.43</td>
<td>47.2%</td>
<td>35%</td>
</tr>
<tr>
<td>Dairy</td>
<td>2</td>
<td>77.4%</td>
<td>53.3%</td>
</tr>
<tr>
<td>Fish</td>
<td>0.79</td>
<td>15.1%</td>
<td>18.3%</td>
</tr>
<tr>
<td>Poultry</td>
<td>0.57</td>
<td>24.5%</td>
<td>18.3%</td>
</tr>
<tr>
<td>Red Meat</td>
<td>0.13</td>
<td>98.1%</td>
<td>93.3%</td>
</tr>
</tbody>
</table>

<sup>a</sup>Mediterranean Diet Pyramid.
recommendation of two daily servings. The ten recommended servings of grains (USDA FGP) was met or exceeded by 30.2% of the male population and 49.1% of males met the eight recommended servings of grains from the MD. Greater than half of the male population met the recommendation of three servings of dairy (USDA FGP) and 77.4% met the MD recommendation of two daily servings.

The MD recommendation for red meat was exceeded by 98.1% of males and 93.3% of females with 50% of the male population consuming greater than 1.9 servings (14 times greater) and 50% of the female population consuming greater than 1 serving (8 times greater) per day. On the other hand, fish and poultry consumption was much lower in this population, with a majority of the population not consuming either meat (females - 68.3% for fish, 55% for poultry; males – 69.8% for fish, 60.4% for poultry).

Sweets and potatoes were often exceeded by this population as well. Nearly 55% of males and 67% of females exceed the daily recommendation for sweets, while 75% of males and 53% of females exceeded the recommendation for potatoes.

**Correlations Between Demographic Characteristics and Food Consumption of the Adolescent Population**

Correlations between demographic parameters and food consumption for females and males are listed in Tables 15 and 15, respectively. As expected, percent body fat was strongly and positively associated with Body Mass Index for both males (0.888) and females (0.854). Age had small positive correlations with BMI (0.275), reported alcohol use (0.354), and cheese pie consumption (0.364) in males and nut consumption (0.317) and margarine use (0.529) in females. Small negative correlations were found between
age and reported exercise (-0.3) and milk consumption (-0.295) in males while chocolate had a small significant negative correlation (-0.258) with age in females. BMI for males was also found to have slight negative correlations with chocolate milk consumption (-0.3) and butter use (-0.289) and ice cream consumption (-0.282) in females. Negative correlations were found between eggs, cheese, milk, chocolate milk, total dairy, and butter consumption with percent body fat in males. Grains, pizza, and ice cream also have small significant negative correlations with percent body fat in females. Reported alcohol consumption in females had positive correlations with medium-fat meat (0.268), red meat (0.335), and chips (0.371). A small negative correlation was also found between oil consumption and exercise (-0.299) in females. Reported smoking habits (as determined from the demographic questionnaires) showed numerous significant correlations in males including, a positive correlation with age, BMI, reported alcohol, milk and coffee, as well as croissant consumption. There were also negative correlations between reported exercise and fish consumption. Only coffee consumption was significantly associated with smoking in the female population (0.288).
Table 14. Correlations* between demographic parameters and mean food group servings in females.

<table>
<thead>
<tr>
<th>Group</th>
<th>Age</th>
<th>BMI</th>
<th>Percent body fat</th>
<th>Reported Smoking</th>
<th>Reported Alcohol</th>
</tr>
</thead>
<tbody>
<tr>
<td>Percent body fat</td>
<td>-0.193</td>
<td>0.854**</td>
<td>1</td>
<td>0.204</td>
<td></td>
</tr>
<tr>
<td>Grains</td>
<td>-0.238</td>
<td>-0.329*</td>
<td>0.096</td>
<td>-0.032</td>
<td></td>
</tr>
<tr>
<td>Medium meat</td>
<td>-0.073</td>
<td>-0.007</td>
<td>-0.1</td>
<td>0.085</td>
<td>0.268*</td>
</tr>
<tr>
<td>Red meat</td>
<td>-0.023</td>
<td>-0.065</td>
<td>-0.17</td>
<td>0.229</td>
<td>0.335*</td>
</tr>
<tr>
<td>Pizza</td>
<td>-0.022</td>
<td>-0.161</td>
<td>-0.272*</td>
<td>0.007</td>
<td>-0.084</td>
</tr>
<tr>
<td>Nuts</td>
<td>0.317*</td>
<td>-0.018</td>
<td>-0.087</td>
<td>0.059</td>
<td>0.118</td>
</tr>
<tr>
<td>Coffee</td>
<td>0.219</td>
<td>0.067</td>
<td>0.048</td>
<td>0.288*</td>
<td>0.175</td>
</tr>
<tr>
<td>Ice cream</td>
<td>0.054</td>
<td>-0.282*</td>
<td>-0.275*</td>
<td>0.065</td>
<td>-0.059</td>
</tr>
<tr>
<td>Chocolate</td>
<td>-0.258*</td>
<td>-0.113</td>
<td>-0.104</td>
<td>-0.175</td>
<td>-0.127</td>
</tr>
<tr>
<td>Chips</td>
<td>-0.052</td>
<td>-0.162</td>
<td>-0.198</td>
<td>0.064</td>
<td>0.371**</td>
</tr>
<tr>
<td>Margarine</td>
<td>0.529**</td>
<td>-0.125</td>
<td>-0.218</td>
<td>0.042</td>
<td>0.253</td>
</tr>
</tbody>
</table>

*Statistically significant at p ≤ 0.05.

**Statistically significant at p ≤ 0.01.

*Correlation coefficient.
Table 15. Correlations\(^*\) between demographic parameters and mean food group servings in males.

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Age</th>
<th>BMI</th>
<th>Percent body fat</th>
<th>Reported Smoking</th>
<th>Reported Alcohol</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>1</td>
<td>-</td>
<td>-</td>
<td>0.473**</td>
<td>-</td>
</tr>
<tr>
<td>BMI</td>
<td>0.275*</td>
<td>1</td>
<td>-</td>
<td>0.301*</td>
<td>-</td>
</tr>
<tr>
<td>Percent body fat</td>
<td>0.156</td>
<td>0.888**</td>
<td>1</td>
<td>0.234</td>
<td>-</td>
</tr>
<tr>
<td>Reported Alcohol</td>
<td>0.354*</td>
<td>0.011</td>
<td>-0.012</td>
<td>0.270*</td>
<td>1</td>
</tr>
<tr>
<td>Reported Exercise</td>
<td>-0.300*</td>
<td>-0.106</td>
<td>-0.125</td>
<td>-0.478**</td>
<td>-0.13</td>
</tr>
<tr>
<td>Fish</td>
<td>-0.112</td>
<td>-0.177</td>
<td>-0.172</td>
<td>-0.301*</td>
<td>-0.191</td>
</tr>
<tr>
<td>Cheese pie</td>
<td>0.364**</td>
<td>0.069</td>
<td>-0.215</td>
<td>0.212</td>
<td>0.203</td>
</tr>
<tr>
<td>Eggs</td>
<td>0.22</td>
<td>-0.183</td>
<td>-0.296*</td>
<td>0.032</td>
<td>0.247</td>
</tr>
<tr>
<td>Cheese</td>
<td>0.095</td>
<td>-0.268</td>
<td>-0.342*</td>
<td>0.030</td>
<td>0.083</td>
</tr>
<tr>
<td>Milk</td>
<td>-0.295*</td>
<td>-0.259</td>
<td>-0.276*</td>
<td>0.311*</td>
<td>-0.17</td>
</tr>
<tr>
<td>Chocolate milk</td>
<td>-0.134</td>
<td>-0.300*</td>
<td>-0.288*</td>
<td>0.094</td>
<td>-0.071</td>
</tr>
<tr>
<td>Total dairy</td>
<td>-0.081</td>
<td>-0.307*</td>
<td>-0.364**</td>
<td>-0.132</td>
<td>-0.028</td>
</tr>
<tr>
<td>Coffee</td>
<td>0.249</td>
<td>0.103</td>
<td>0.002</td>
<td>0.477**</td>
<td>-0.003</td>
</tr>
<tr>
<td>Croissant</td>
<td>-0.1**</td>
<td>-0.213</td>
<td>-0.201</td>
<td>0.331*</td>
<td>-0.208</td>
</tr>
</tbody>
</table>

*Statistically significant at \( p \leq 0.05 \).

**Statistically significant at \( p \leq 0.01 \).

*Correlation coefficient.
Comparison with Data from Other Countries

Tables 16, 17, and 18 are compilations of data from other countries which are expressed in different forms and due to differing formats and units, could not be combined. Table 16 represents the percentages of adolescent populations who have consumed at least one serving of each of the listed food groups. Results from this study revealed that only 25% of Greek adolescents consumed a minimum of one piece of fruit or serving of 100% fruit juice, 88% consumed at least one serving of vegetables, 92% consumed at least one serving of dairy (including milk, cheese, yogurt, or ice cream), and 87% consumed at least one serving of meat (including either red meat, fish, or poultry). A higher percentage of males consumed meats than females (92.5 versus 83.1%). Also nearly 41% on average consumed at least one serving of soda, 44% consumed at least one serving of sweets (ice cream, chocolate, cakes, cookies), 27% consumed at least one serving of French fries, and 35% consumed at least one coffee product (Nescafe, café au lait, etc.). Finally, a greater percentage of females from the Greek adolescent population consumed at least one serving of coffee versus males (42.7 versus 27%). A greater percentage of French adolescents consumed meat and fruits, but a much smaller percentage consumed vegetables and a greater percentage of Spanish adolescents consumed fruits daily, but significantly less vegetables and dairy (Table 16). Data for fast foods and sweets could only be compared with results from Yannakoulia, et al., (2004a) which included younger Greek adolescents between the ages of 12.5 and 15.5 years who consumed more fruits, soda and dairy, and less vegetables, coffee products, and sweets.
Table 16. Comparison of adolescents consuming at least one serving from food groups in different countries.

<table>
<thead>
<tr>
<th>Country</th>
<th>Age range</th>
<th>Gender</th>
<th>Fruits</th>
<th>Vegetables</th>
<th>Dairy</th>
<th>Meat</th>
<th>Soda</th>
<th>Sweets</th>
<th>Coffee</th>
</tr>
</thead>
<tbody>
<tr>
<td>France</td>
<td>15-34</td>
<td>M &amp; F</td>
<td>70.7</td>
<td>74.1</td>
<td>93.4</td>
<td>94.3</td>
<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
</tr>
<tr>
<td>Greece</td>
<td>12.5 – 15.5</td>
<td>M</td>
<td>81</td>
<td>41</td>
<td>87.1</td>
<td>n/a</td>
<td>56.8</td>
<td>39.7</td>
<td>14.9</td>
</tr>
<tr>
<td></td>
<td></td>
<td>F</td>
<td>81.2</td>
<td>44</td>
<td>82</td>
<td>n/a</td>
<td>38.9</td>
<td>40.3</td>
<td>12.9</td>
</tr>
<tr>
<td>Greece</td>
<td>14 – 25</td>
<td>M</td>
<td>24.5</td>
<td>90</td>
<td>92.5</td>
<td>92.5</td>
<td>42.1</td>
<td>58.5</td>
<td>27</td>
</tr>
<tr>
<td></td>
<td></td>
<td>F</td>
<td>25</td>
<td>86.7</td>
<td>91.7</td>
<td>83.1</td>
<td>39.4</td>
<td>53.9</td>
<td>42.7</td>
</tr>
<tr>
<td>Spain</td>
<td>15 – 24</td>
<td>M</td>
<td>85.1</td>
<td>75.3</td>
<td>50.4</td>
<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
</tr>
<tr>
<td></td>
<td></td>
<td>F</td>
<td>85.9</td>
<td>82.4</td>
<td>45.8</td>
<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
</tr>
</tbody>
</table>

*a*percentage

*b*Volatier & Verger, 1999

*c*Yannakoulia, et al., 2004a

*d*Results from this study

*e*Serra-Majem, et al., 2004

*n/a* – no data available
Table 17 compares average daily servings of food groups with those from U.S. adolescents between the ages of 12 and 19 years and children between the ages of 9 and 14 years and British adolescents between the ages of 16 and 24 years. No other researchers to our knowledge have evaluated food group-based consumption in adolescents. The Greek males from this study appear to consume more grains (9.9 versus 7.3 servings), dairy (3.4 versus 2.4 servings), and meats (10.4 versus 5.3 ounces) than the male adolescents from the United States. Fruit and vegetable consumption appeared to be similar between male adolescents. The female adolescents from this population appeared to consume fewer vegetables (1.77 versus 2.8 servings), more dairy (2.29 versus 1.7) and more meat (6.35 versus 3.9 ounces) than female adolescents from the United States. Grain and fruit consumption is closer among female adolescents and overall fruit servings appear to be similar across all studies. The results from Rockett, et al., (2001) in the United States show that female children consumed significantly greater servings of grains, total fruits and vegetables, and dairy and significantly less amounts of meat than Greek female adolescents. On the other hand, male children consumed significantly less grain products and meats than Greek male adolescents. Consumption of dairy and total fruits and vegetables were similar between the United States and our Greek population (Munoz, et al., 1997). However, vegetable consumption was significantly less in the United Kingdom population (Doyle & Hosfield, 2001).
Table 17. Comparison of food group-based consumption of adolescents in different countries.

<table>
<thead>
<tr>
<th>Country</th>
<th>Age range</th>
<th>Gender</th>
<th>Grains</th>
<th>Fruits</th>
<th>Vegetables</th>
<th>Dairy</th>
<th>Meat</th>
</tr>
</thead>
<tbody>
<tr>
<td>U.S. adolescents</td>
<td>12.0 – 19</td>
<td>M</td>
<td>7.3</td>
<td>1.1</td>
<td>3.4</td>
<td>2.4</td>
<td>2.12</td>
</tr>
<tr>
<td></td>
<td></td>
<td>F</td>
<td>5.1</td>
<td>1.1</td>
<td>2.8</td>
<td>1.7</td>
<td>1.56</td>
</tr>
<tr>
<td>Greek adolescents</td>
<td>14-25</td>
<td>M</td>
<td>9.93</td>
<td>0.87</td>
<td>3.14</td>
<td>3.4</td>
<td>4.16</td>
</tr>
<tr>
<td></td>
<td></td>
<td>F</td>
<td>5.22</td>
<td>0.94</td>
<td>1.77</td>
<td>2.29</td>
<td>3.9</td>
</tr>
<tr>
<td>United Kingdom</td>
<td>16 – 24</td>
<td>M &amp; F</td>
<td>n/a</td>
<td>1.1</td>
<td>0.9</td>
<td>n/a</td>
<td>n/a</td>
</tr>
</tbody>
</table>

*a servings
F & V: Fruits and vegetables
b Munoz, et al., 1997
c Results from this study
d Doyle & Hosfield, 2001
n/a – no data available
Table 18 presents consumption of fruits and vegetables (gram weight) in populations from adults around the world. The Greek adult population (Trichopoulou, et al., 1996) in this study consumed significantly greater amounts of fruits and vegetables than any other country and exceeded the World Health Organization minimum of 400 grams (WHO, 1990) of combined fruits and vegetables per day. Unfortunately, results from this study show that Greek adolescents do not appear to be following the good habits of their elders. On average, adolescents consumed only 268 grams of fruits and vegetables compared with 617 grams consumed by adults (Naska, et al., 2000). Yet, Greek adolescents still consumed greater amounts of fruits and vegetables than Ireland and the United Kingdom (Naska, et al., 2000).

Table 18. Comparison of fruit and vegetable consumption of adults in different countries.

<table>
<thead>
<tr>
<th>Country</th>
<th>Fruits (grams)</th>
<th>Vegetables (grams)</th>
<th>Total (grams)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Greece</td>
<td>350</td>
<td>267</td>
<td>617</td>
</tr>
<tr>
<td>Spain</td>
<td>308</td>
<td>180</td>
<td>488</td>
</tr>
<tr>
<td>Belgium</td>
<td>198</td>
<td>162</td>
<td>360</td>
</tr>
<tr>
<td>Germany</td>
<td>202</td>
<td>141</td>
<td>343</td>
</tr>
<tr>
<td>Poland</td>
<td>100</td>
<td>202</td>
<td>302</td>
</tr>
<tr>
<td>Norway</td>
<td>174</td>
<td>102</td>
<td>276</td>
</tr>
<tr>
<td>Greece (adolescents)</td>
<td>75</td>
<td>193</td>
<td>268</td>
</tr>
<tr>
<td>Ireland</td>
<td>103</td>
<td>130</td>
<td>233</td>
</tr>
<tr>
<td>UK</td>
<td>132</td>
<td>158</td>
<td>190</td>
</tr>
</tbody>
</table>

*aAdapted from Naska, et al., 2000
bTrichopoulou, et al., 1996
Adolescents from this study.
Food Consumption Patterns

ANOVA tests demonstrated that data from each time interval studied during the day (seven time intervals) were not significantly different among the three days studied. Thus, time interval data were averaged into one day of seven time intervals.

The trends viewed from the time interval data followed a pattern which was similar in most food groups. In this pattern, there were only two apparent meal times: the first during the 12:00 – 4:00pm and the second during the 8:00 – 11:00pm. The first peak of consumption was greater than the second peak, indicating that more foods as well as a greater percentage of the population ate during this time interval. This pattern will be considered the normal curve. Figures 6 and 7 describe the number of average daily servings of grains and the percent of the population consuming grains throughout the day. Males consumed significantly more grains than females during time 3 (12:00 – 3:59pm), time 4 (4:00 – 7:59pm), time 5 (8:00 – 10:59pm), and time 6 (11:00 – 2:59am) (p ≤0.01). A similar trend is shown in the percent of population consuming grains during the above times (Figure 6b). While only 21% of males and 12% of females consumed grains in the morning, greater than 65% and 45% of the total population consumed grains during the mid-day and evening periods.
Figure 6. Average servings of grains by time.

Time intervals

**Statistically significant at each time interval at \( p \leq 0.01 \).

Figure 7. Percent of population consuming grains during the day.
Figures 8 and 9 represent vegetable consumption for Greek male and female adolescents throughout the day. Average servings of vegetables were significantly greater in males than females during times 3 (12:00 – 3:59pm), 5 (8:00 – 10:59pm), and 6 (11:00 – 2:59pm) (p ≤0.01). During time 3, males consumed nearly an entire serving of vegetables more than females. However, as demonstrated in figure 9, the percent of males consuming vegetables during each time period was almost identical to the percent of females consuming vegetables. Sixty percent of both genders consumed vegetables during time 3.

Average French fry consumption and the percent of population consuming French fries can be viewed in Figures 10 and 11. Average consumption peaked just over 1/3 of a serving per male and just under 1/4 serving per female. These, too, followed the normal curve seen with other food groups and were not significant at any time interval. The percent of population consuming French fries was nearly identical for both males and females and peaked during time 3 (12:00 – 3:59) at approximately 14% of the population.

Average fruit consumption and percent population consuming fruit is presented in Figures 12 and 13. Unlike the normal trends viewed in other food groups, average fruit consumption appears to have only a single peak during time 4 (4:00 – 7:59pm) for females and time 5 (8:00 – 10:59pm) for males. A similar trend is apparent in the percentage of population of males and females consuming fruit during the day (Figure 13), revealing that only 9% of females and 7.8% of males consumed fruits at times 4 and 5, respectively. No significant differences were detected in either amount or percent of population for fruit consumption between males and females.
Figure 8. Average serving of vegetables by time.

![Average serving of vegetables by time.](image)

**Statistically significant at each time interval at \( p \leq 0.01 \).

Figure 9. Percent of population consuming vegetables during the day.

![Percent of population consuming vegetables during the day.](image)
Figure 10. Average servings of French fries by time.

Figure 11. Percent of population consuming French fries during the day.
Figure 12. Average servings of fruit by time.

Figure 13. Percent of population consuming fruit during the day.
Average ounces of red meat (all animal meats: beef, pork, lamb, rabbit, etc.) and the percent population consuming red meat are expressed in Figures 14 and 15. According to the data, males consumed significantly more red meat than females during times 3 through 7 (12:00 – 2:59am) (p ≤0.05 during times 3 and 4 and p ≤0.01 during times 5 and 6). It is apparent that the red meat trend deviates slightly from the normal trend, as explained in the beginning of this section. The second peak (8:00 – 10:59 pm), which is typically smaller than the first peak (12:00 – 3:59pm), was greater for males by nearly half an ounce on average. While the percent of population consuming red meat was similar from time 1 to 3 (6:00am – 3:59pm), a greater percent of males (approximately 10%) tended to consume red meat into the evening between times 4 (4:00 – 7:59pm) through 6 (4:00 – 2:59am).

Figures 16 and 17 reflect data concerning fish consumption. Absolutely no fish was consumed by any subject before the third time interval (noon). No significance differences were noted between males and females for either amount of fish consumed or the percent of population that consumed fish. After the mid-day meal (time 3, 12:00 – 3:59pm), the amount of fish consumption dropped.

Figures 18 and 19 illustrate poultry consumption and the percent of population consuming poultry throughout the day. No significant differences were found for either ounces consumed by gender or the percent by gender consuming poultry.
Figure 14. Average ounces of red meat by time.

Figure 15. Percent of population consuming red meat during the day.
Figure 16. Average ounces of fish by time.

Figure 17. Percent of population consuming fish during the day.
Figure 18. Average ounces of poultry by time.

Figure 19. Percent of population consuming poultry during the day.
Average milk consumption by time and percent of population drinking milk throughout the day are presented in Figures 20 and 21. The average serving of milk was higher in males than females during time 1 (6:00 – 8:59am; 0.42 servings versus 0.15 servings) (p ≤0.01). Similar results were seen in the percent population data which demonstrate that nearly 35% of the male population (approximately double that for females) consumed milk during this time. The peak for female milk consumption can be seen during time 2 (9:00 – 11:59am). During this time interval, an average of 0.33 servings of milk were consumed and approximately 30% of the female population consumed milk. Milk consumption plummeted for both males (after time 1, 6:00 – 8:59am) and females (after time 2, 9:00 – 11:59am) with only a small higher trend in female consumption and percent female population drinking milk during time 5 (8:00 – 10:59pm).

Cheese consumption follows the normal curve for the pattern of this population. However, a substantial amount of these adolescents consume cheese throughout the day. In fact, as Tables 22 and 23 explain, nearly 45% of the male and 40% of the female population consumed cheese during the mid-day peak with sex-specific total average servings of approximately 0.7 and 0.46, respectively. Male consumption of cheese was significantly greater than females (at a p ≤0.05) during time 5 (8:00 – 10:59pm).
Figure 22. Average servings of cheese by time.

*Statistically significant at each time interval at $p \leq 0.05$.

Figure 23. Percent of population consuming cheese during the day.
According to Figure 24, significantly more females (p \leq 0.05) consumed coffee, which was typically Nescafe, during time 2 (9:00 – 11:59am) than males. Female coffee consumption was consistently greater than males throughout the day until after time 6 (11:00pm). Female consumption peaked during time 2 (9:00 – 11:59am) then slowly descended through time 4 (4:00 – 7:59pm). Male consumption peaked during time 3 (12:00 – 3:59pm) with a more rapid descent in consumption apparent later in the day. A nearly identical trend in percent population consuming coffee can be viewed in Figure 25. Approximately 13% of this Greek female adolescent population consumed coffee during times 2 (9:00 – 11:59am) through time 4 (4:00 – 7:59pm). Percent male coffee consumption peaked at slightly greater than 12% during time 3 (12:00 – 3:59pm), then dropped progressively through the day.

Sweetened beverages, such as non-diet soft drinks and sweetened lemonade, on the other hand showed almost a completely opposite set of data which can be viewed in Figures 26 and 27. Average female consumption followed the normal observed curve (page 60) with a peak during the mid-day meal and approximately 16% of the population consuming sweetened beverages (mostly non-diet soft drinks). However, a greater percent of males (approximately 7% during time 5, 8:00 – 10:59pm) consumed greater average servings of sweetened beverages starting at time 4 (4:00pm) through 6 (2:59am). This percent was significant (p \leq 0.05) during time 5 (8:00 – 10:59pm) with an average of 0.25 serving increase in males.
Figure 24. Average servings of coffee during the day.

*Statistically significant at each time interval at \( p \leq 0.05 \).

Figure 25. Percent of population drinking coffee during the day.
Figure 26. Average servings of sweetened beverages by time.

*Statistically significant at each time interval at \( p \leq 0.05 \).

Figure 27. Percent of population drinking sweetened beverages during the day.
Figures 28 and 29 illustrate the average servings of sweets by time and the percent population consuming them throughout the day. Males consumed significantly greater average servings of sweets during times 1 (6:00 – 8:59am) and 6 (11:00 – 2:59am) than females. This finding is also apparent in percent population differences during time 1 in which nearly 7% of the male population consumed sweets compared with less than 1% of the female population. The pattern of sweet consumption is also different between males and females. Average sweet consumption peaked during time 3 (12:00 – 3:59pm) for females and time 4 (4:00 – 7:59pm) for males reaching average amounts of 0.65 servings per female and 0.65 servings of sweets per male. After time 4, both the average servings and the percent of population consuming sweets decreased.

Additional data that follow the normal trend of food consumption during the time periods studied (as previously defined), are presented in Appendix E. These included, potatoes; lean, medium-fat, and high-fat meats; nuts, eggs, legumes, and total meat-substitutes.
Figure 28. Average servings of sweets by time.

![Graph showing average servings of sweets by time.](image)

*Statistically significant at each time interval at $p \leq 0.05$.

Figure 29. Percent of population consuming sweets during the day.

![Graph showing percent of population consuming sweets by time.](image)
Chapter 5

DISCUSSION

One hundred and thirteen Greek adolescents participated in the dietary assessment part of this study. Females composed 53% and males 47% of the population. It should be noted that as our population included only 113 adolescents from an urban area, our results may not be representative of the Greek adolescent population; however the results may offer clues and trends about this population. Mean ages were not significantly different between males and females, but as expected, males had a significantly higher BMI and significantly lower percentages of body fat than females. This data complies with normal physiologic differences between males and females, as evaluated by Tanner (1962). Values of percent body fat <20% for males and <25% for females are considered normal (Heunemann, et al., 1966). Percentages of body fat between 20% and 25% for males and 25 and 30 % for females are considered overweight and values above these classified as obesity. Thus, according to this data, 26.7% of the female population and 11.3% of the male population would be classified as overweight and 25% of females and 5.7% of males would be classified as obese. However, overweight and obesity are commonly classified according to the cut off points for Body Mass Index (BMI) set by Cole, et al., (2000). Under these standards, a BMI of ≥25-29.9 is considered overweight and ≥30 as obese for females and a BMI of ≥25-27.9 as overweight and ≥ 28 as obese for males. Thus, 16.7% of females and 22.6% of males were overweight, while 1.6% of females and 11.3% of males were obese in our population group, according to this classification scheme. Although the differences between these classifications are
significant, there is a strong positive correlation between percent body fat and BMI indicating that most participants with an elevated BMI also had elevated percentages of body fat. It should be taken into consideration that the high rates of BMI in the male population may be secondary to a greater percentage of muscle mass (Cole, et al., 2000).

These findings are comparable to overweight and obesity rates in adolescents from other countries (Munoz, et al., 1997; Savva, et al., 2002). Munoz, et al., (1997) reported that 12.4% and 13.9% of their U.S. adolescent population were overweight and obese, respectively. In Cyprus, Savva, et al., (2002) found that 16.9% of males and 13.1% of females were overweight with obesity rates of 10.3% for males and 9.1% for females. This Cypriot population was a younger group of adolescents and therefore the BMI rates for males were significantly lower than males from our study, most likely secondary to increased muscle mass (Cole, et al., 2000). The data from our adolescent population are still significantly lower than the overweight and obesity trends in the United States. Still, Greece came in second for overweight and obesity rates behind the United States when 13 and 15 year olds from 14 countries were compared (U.S. Department of Health and Human Services, 2004).

Greater than 60% of females and 71% of males reported daily moderate to vigorous activity; still, 40% of females and 29% of males reported little or no exercise. This data is comparable with data from Savva, et al., (2002) in Cypriot children and by Moreno, et al., (2002) in Spanish adolescents. Although no correlation was apparent between BMI or percent body fat with reported exercise habits, exercise is an essential part of a healthy lifestyle and inactivity, despite level of caloric intake can promote
overweight and obesity (Rockett, et al., 2001). Therefore, education focused towards promoting physical activity in addition to nutrition, is necessary.

Smoking was also a concern in this population. Nearly 40% of the males and 45% of the females smoked cigarettes compared to 35% of the adolescents in the United Kingdom (Doyle & Hosfield, 2001) and female adolescents in the United States (Wilson & Nietert, 2002). In evaluating smokers versus non-smokers, Wilson and Nietert (2002) determined that there was an evident dose-response of smoking on food group consumption; as the amount of cigarettes smoked increased, there was a concomitant decrease in fruit, vegetable, and milk intake. Thus, they concluded that smoking may be representative of other unhealthy behaviors, including poor eating habits. There were positive correlations in our male and female population with coffee and reported alcohol intake and BMI in males, and a significant negative correlation with exercise in males. Thus, our data concur with the above studies (Wilson & Nietert, 2002; Doyle & Hosfield, 2001) and signify that smoking in this population may also insinuate other poor habits, such as alcohol consumption and inactivity. Since it is well documented that smoking is harmful and has been linked to certain cancers and other diseases, the high incidence of smoking in this population is of great concern. Education should be offered to this population regarding not only smoking cessation, but initial prevention.

Only 13.5% of males and 6.7% of females reported that they consumed alcohol. It should be noted that no significant correlation was found between reported alcohol consumption and actual alcohol consumption from the food diary. The validity of this finding is questioned since the demographic survey responses were based on approximate weekly amounts and this study only recorded three of the days of the week. The
relationship between age and alcohol consumption was most likely not a factor in the small percentage of the population consuming alcohol since there is no age limit for alcohol consumption in Greece; however, there was a small positive correlation between age and reported alcohol use in males. The low rate of alcohol consumption was most likely secondary to the increased rates of abstention in the Mediterranean region as discussed by Bloomfield, et al., (2003). In a review on alcohol consumption in Europe, these authors reported that in the Mediterranean region (particularly in the younger population), inhabitants were consuming less quantities of alcohol than those in the central European countries.

Although small amounts of alcohol are believed to be beneficial, especially red wine (Caimi, et al., 2003), excess alcohol intake may result in unwelcome side effects including the intake of excess calories leading to weight gain, the replacement of nutritious foods in the diet leading to inadequate nutrient intake, and more seriously, liver disease (Schmidt & Popham, 1975). Only 3.6% of this population reported being heavy consumers of alcohol (greater than 10 drinks per week), which was lower than rates from most other European countries (Bloomfield, et al., 2003), but education should still address these potential side effects as well as the potential benefits.

The data from the demographic questionnaires were very beneficial in identifying problematic areas in the health of this population. Although alcohol consumption does not appear to be an area of concern in this adolescent population, it is imperative that rates of smoking and inactivity be addressed.

The results from this food-group based study provide evidence of the Nutrition Transition that has taken effect among these Greek adolescents. It is evident that this
The population is no longer following the traditional Mediterranean Diet (MD) described by Keys, et al., (1986) which included high amounts of plant products and low amounts of meats and saturated fats. The typical diet that now seems to exist in this population is representative of the Nutrition-Related Non-Communicable Disease Pattern (NRNCP) described by Popkin (2002), during which greater amounts of meat products, refined grains, high fat foods and snacks are consumed in combination with decreased physical activity patterns. The data from this study also showed evidence that poor eating patterns may have developed in this population including low breakfast consumption and late-night meals.

Food-group based consumption revealed that males consumed significantly greater amounts of grains, meats, and dairy products than females. Previous results from the HNA study indicated that this male population consumed 2900 kcalories on average as compared to 1860 kcalories by females (Yannakoulia, et al., 2004b). Therefore, it is not surprising that males consumed greater amounts of many of these foods including grains, vegetables, and meats. However, they also appear to be consuming more of the high fat foods listed in the “other” group, including gyros and souvlaki, pizzas, and French fries. On average, males consumed 1/2 of a burger, 1/2 of a slice of pizza, 1/2 of a serving of souvlaki, 1/3 of a slice of cheese pie and 3/4 of a serving of French fries every day; females consumed significantly less servings of all these foods. When compared to Spanish (Serra-Majem, et al., 2004) and United States (Munoz, et al., 1997) adolescents of the same age and younger Greek adolescents (Yannakoulia, et al., 2004a), this population consumed significantly greater amounts of meat and milk products. Females consumed fewer fruits than other adolescents in Spain and the United States and
less grains than their younger counterparts, but similar amounts to U.S. female adolescents (Rockett, et al., 2001; Yannakoulia, et al., 2004a; Serra-Majem, et al., 2004).

Story, et al., (1986) and Farthing (1991) discussed the development of disordered eating habits that tend to develop during adolescence. Data from the HNA study (Yannakoulia, et al., 2004b) demonstrated that 7.3% of males and 20.3% of females scored at or above 20 in the EAT-26 (Eating Attitudes Test) thereby exhibiting abnormal eating attitudes. These were some of the highest reported values in European and non-European countries. The authors also mention that carbohydrate-phobia is typical in this population, especially in females, which may explain why grain consumption viewed in our data was low.

When mean servings were compared with recommendations from the MD Pyramid and the USDA Food Guide Pyramid (FGP), fruit and vegetable recommendations were most often not met and meats, sweets, and potato recommendations were most often exceeded.

Due to lack of adequate information, whole grains could not be separated from refined grain products. This information would have been useful in defining a shift in grain choices from those recommended by the MD Pyramid. Results from a study conducted by Harnack, et al., (2003) using data from the Continuing Survey of Food Intakes by Individuals showed that of the average 7.7 servings of grains consumed by adolescents between the ages of 12 and 18 years, only one was a whole grain. With a large portion of the 7.4 average grain servings in this population of adolescents coming from fast foods, including burgers, pita with souvlaki, pizzas, and pastas, it is doubtful that they are receiving adequate amounts of whole grains, which have potential benefits
in protecting against cardiovascular disease and certain cancers of the gastro-intestinal tract (Lorenz & Lee, 1997; Bingham, et al., 2003). Harnack, et al., (2003) suggested that education focused toward distinguishing between whole grain and highly processed non-whole grain items as well as enforcing their benefits, is necessary in achieving the recommendations. They concluded that if consumer demand for whole grain products increases, the market will respond by providing more whole grain products for their consumption. However, without education, population choices will not change.

Fruits and vegetables contain fiber, vitamins and minerals, and antioxidants that are beneficial in preventing certain forms of cancer and disease (Heber, 2004; Lapointe, et al., 2005). Unfortunately, they are severely lacking in this population. On average, males and females consumed less than one serving of fruit and approximately 1.5 servings of vegetables per day. The Data Food Networking (DAFNE) project (Naska et al., 2000) was conducted to evaluate fruit and vegetable consumption across Europe. Adults in Greece consumed approximately 617 grams of fruits and vegetables per day which was the highest amount of any other countries, including Spain, the United Kingdom, Germany, and Poland. They also had the highest percent of the population meeting the recommendations for fruits and vegetables. Sixty-eight percent met the recommendations for fruits and 44% met the recommendations for vegetables, in comparison to 54% and 12% from Germany, 19% and 25% from Poland, and 70% and 24% from Spain fruit and vegetable consumption, respectively. However, the data from our study reported here, demonstrated that our adolescent population in Greece was not consuming comparable amounts of fruits and vegetables as their elders. Adolescents from this study did not even meet the 400 gram minimum recommendation set by the
World Health Organization and even more disappointing is that greater than 60% of males and females did not report any fruit consumption and greater than 50% reported less than 1.5 servings of vegetables per day. None of the male or female adolescents met the USDA FGP or MD Pyramids recommendations for fruits. For vegetables, only a low percent of males met the USDA FGP recommendation (11.3%) or the MD Pyramid recommendation (6.7%). These percentages are much lower than those for American adolescents reported by Munoz, et al., (1997). They found that approximately 48% of adolescents met the recommendation for vegetables and 18% met the recommendation for fruits.

Public education, through the media, to increase fruit and vegetable consumption has been beneficial in the United States (Oppen & Sugerman, 2002) as well as in the United Kingdom (Doyle & Hosfield, 2001) and Finland (Pekka, et al., 2001). It is therefore advisable that education through the Greek Ministry of Public Health and the Ministry of Education regarding fruit and vegetable consumption be initiated targeting primary and secondary education and education of physicians to increase public awareness in the community. It may also be prudent to enlist the assistance of the media.

Total meat serving recommendations set by the USDA FGP were exceeded by males, but not females. However, when poultry, fish, and red meat were evaluated separately according to recommendations from the MD Pyramid, it was evident that red meats were most often consumed by both males and females. In fact, red meat consumption was 330% greater in males and 175% greater in females than consumption of fish and poultry combined. Although side effects of excessive protein intake, particularly red meats, remain controversial, 62% of the meat products consumed were
medium-fat or high-fat meats which offer significant amounts of saturated fat to the diet. Menghetti, et al., (2004) also found significant correlations between excessive protein intake and risk of hypertension in obese children. Lytle, et al., (1996) believe that the best way to decrease saturated fat amounts in the diet is to reduce the amounts of meat products that are consumed. Thus, in place of high meat product meals, a more vegetarian approach, like the MD, should be taken. Previously published results from the HNA study (Klimis-Zacas, et al., 2001; Papoutsakis-Tsarouhas, et al., 2001) demonstrated that female adolescents were not meeting set Recommended Dietary Intake (RDAs) for a majority of nutrients including calcium, iron, selenium, manganese, magnesium, vitamins E and D, as well as thiamin, niacin, and folic acid and males were not meeting RDAs for vitamin D, zinc, and magnesium. Therefore, reinforcing vegetable and whole grain consumption over meat items is important to not only meet the USDA FGP and MD Pyramid recommendations, but also to offer a varied diet which will meet Dietary Reference Intakes (DRI) for these adolescents.

Olive oil use could not be separated from total oil use because the participants did not specify type of oil. However, it has been reported that olive oil is the primary oil used in Greece (Yannakoulia, et al., 2004a; Roma-Giannikou, et al., 1997; Trichopoulou, et al., 1996; Trichopoulou, et al., 1999) which could also explain why olive oil use was not specified. Average total oil use greatly exceeded the recommendations from the USDA FGP for both males and females. Fat intake in this population has been shown through numerous studies to greatly exceed recommendations of <30% total kcaltories (Hassapidou & Fontiadou, 2001; Ferro-Luzzi, et al., 2002; Yannakoulia, et al., 2004b). Previously published results from the HNA study found percent kcaltories from dietary fat
in males to be 40.7% and 39.8% in females with 14.2% and 13.4% of kcals in males and females coming from saturated fats (Yannakoulia, et al., 2004b).

Dairy, meat, and baked goods were the main contributors of saturated fat in the diets of a sample of U.S. adolescents (Lytle, et al., 1996). Our population consumed large amounts of all these foods with average servings of 2.8 dairy products (mostly whole milk and cheeses), 3.3 meat products (half of which was medium-fat meats), and 2 sweets (ice cream, chocolate, cakes, and cookies) per day. Lytle, et al., (1996) concluded that educational materials should stress the importance of choosing nonfat or reduced fat dairy products, low fat baked goods, and either consuming low fat meats or few meat products in general. Similar recommendations are expressed by the USDA FGP (Advisory Committee, 2005). Label reading to compare total and saturated fat content of products is also important, not only for adolescents, but their parents as well, since adolescents do not typically cook their own meals (Lytle, et al., 1996). Lytle, et al., (1996) also added that food service institutions play a major role in providing foods for adolescents and should also take initiative by re-analyzing their recipes in an effort to decrease fat and saturated fat contents in the foods they offer.

The adolescents of this study also consumed significantly greater servings of sweets than recommended by the MD Pyramid. On average, males and females consumed two servings of cakes, ice cream, chocolate, and/or cookies per day, which is approximately four times the recommendation. As previously discussed, these products not only contribute sugar, but also significant amounts of saturated fat and kcals to the diet. Increased consumption of sweets has been linked to inability to eat a nutritious diet at an energy level that can maintain a healthy weight (Guthrie & Morton, 2000).
Although no recommendation is offered to compare with sweetened beverage consumption, our data showed that males consumed an average of approximately eight ounces and females consumed greater than four ounces of sweetened beverages per day. These amounts are significantly less than the eighteen ounces reported from the United States (Ballew, et al., 2000). Sweetened beverages, typically high in kcalories and low in nutrient density, are linked to obesity and poor nutrient intake in adolescents (Ballew, et al., 2000; Cavadini, et al., 2000; Rampersaud, et al., 2003). Attention should be given to promoting less consumption of sweets overall, but when consumed, sweets made from lower fat milks, fruits, and reduced amounts of sugars; not necessarily from alternative fats and sugar substitutes, should be promoted.

Learning behaviors that affect or inhibit food group consumption is also important in determining methods of promoting healthy eating habits. For instance, determining patterns of fruit and vegetable consumption may be useful in initiating interventions if particular meal times were uncovered from the data that demonstrated low consumption of these foods. However, to our knowledge, time interval data (as used in our research) has not been utilized previously.

Looking at the food pattern data, the lack or low consumption or nonexistent breakfast appears to be of concern in this population. It seems that the prominent food groups consumed during breakfast were grains and dairy. Only approximately 20% of males and 12% of females consumed grain products and 35% of males and 17% of females consumed milk (for example: cereal with milk, toast and milk) for breakfast. Trace amounts of other food groups were consumed during this time (6:00 - 8:59 am). There were small increases in food consumption between 9:00 and 11:59 am, however
most average servings of individual food groups consumed did not peak until the mid-day meal (12:00 – 3:59 pm). Videon and Manning (2002) have found that in the United States, morning meals were often skipped, but were typically low in fat, meat and vegetable products, and high in grain products.

As previously discussed, fruit and vegetable consumption is low in this population. Only trace amounts of fruits on average were consumed prior to the evening meal (8:00 – 11:59 pm). While females appear to consume fruits more as a snack between the mid-day and evening meal, males appear to consume, more around the time of the evening meal. No more than 9% of the population consumed fruit at any one time interval during the day. Therefore, it would be of benefit to not only promote a healthy, balanced breakfast, but to promote fruit consumption during breakfast as well.

Vegetable consumption in this adolescent population also appears to start during the mid-day meal, which shows that these adolescents have gotten away from the traditional breakfast of bread, tomatoes, olives, and cheese (Kafatos, et al., 2000). Although 60% of males consumed nearly 1.5 servings of vegetables during the mid-day meal (12:00 – 3:59 pm), a large portion of these servings came from French fries and other potatoes. Females consumed even fewer servings of vegetables on average, which did not exceed a half serving at any time interval. Aside from implementing a “5-a-day”-like program (Oppen & Sugerman, 2002) to promote fruit and vegetable consumption, helping adolescents replace meat with fruits and vegetables could facilitate low caloric intake and prevent the rise in obesity seen in the adolescent population.

Also of interest are the patterns of beverage consumption (particularly milk and sweetened beverages). Milk consumption during the day initially peaked during the first
time interval (6:00 to 8:59 am) and decreased throughout the rest of the time periods, while the consumption of sweetened beverages increased, peaking for females during the mid-day meal (12:00 – 3:59 pm) and for males during the evening meal (8:00 – 11:59 pm). Although average consumption of milk was significantly greater than average consumption of sweetened beverages (13 ounces versus 6 ounces), Ballew, et al., (2000) stated that the likelihood of meeting recommendations for nutrients, decreases as the consumption of sweetened beverages increase. Others have also reported a negative correlation between milk and soda consumption (Cavadini, et al., 2000; Bowman, 2002; Rampersaud, et al., 2003), however no significant correlation was apparent between milk and soda from our data. Consumption of non-diet soft drinks has also been positively linked to increased energy intake in children, which could potentially lead to excess weight and its associated co-morbidities (Rampersaud, et al., 2003).

Significant gender differences were also apparent in the food pattern data. Males consumed higher amounts of grains, vegetables, and red meats at several times through the day compared to females. Munoz, et al., (1997) found similar results between sexes.

The traditional MD focused around the mid-day meal which included the hearty foods such as stews and meats with a lighter meal consumed in the evening, such as a boiled vegetables, salad, and yogurt (Kafatos, et al., 2000). Based on the food pattern data from our adolescent population, this pattern is still evident, however the evening meals in males were not “light” and generally consisted of high-fat and calorie foods, such as French fries and medium-fat meats in significantly greater amounts than females. This is important since Spear, et al., (2005) found that consuming foods late in the evening. This adolescent population should therefore be deterred from frequently
consuming fast foods, especially late in the evening since rates of overweight and obesity, as well as chronic disease, are steadily increasing in Greece (Cavadini, et al., 2000; Savva, et al., 2002; Magkos, et al., 2005).

Serra-Majem, et al., (2004) conclude that sedentary lifestyles (which have arisen from urbanization and the shift from manual labor work to office work) and decreased time for preparation of meals cannot be changed and instead modifications to the MD should be made to account for these changes while still adhering to the recommendations for which its benefits have been documented.

Barriers to change should be addressed before implementation of nutrition education. Krystallis, et al., (2003) found that although use of low fat products is increasing in Greece, some barriers included taste and mouth-feel, suggesting that many consumers were unhappy with the products available and prefer the flavor that they are used to. Court (1988) writes that adolescents have more important things to focus on than what they are eating, such as sexual maturity, independence from their parents, and school curriculum, but that they are still interested in their well-being and should not be denied proper nutrition education. A study by Olsen (1984) stated that adolescents blamed lack of time and discipline as well as lack of urgency as barriers to changing their dietary habits. It is, therefore, important to make nutrition education appeal to their “here and now” attitudes as well as express how poor dietary habits now will affect them later in life. Other barriers to change should be identified and utilized in this important information if changes are to be made.

However, it is not only the job of the adolescent to analyze what and how they are eating. It is also important that parents and food-service organizations be included in
nutrition education since adolescents do not typically prepare their own meals (Farthing, 1991). Eating meals together is important as Videon & Manning (2003) found adolescents who ate more than three meals a week with their family were more likely to consume fruits and vegetables as well as breakfast.

**Conclusions**

This research study provides data on the dietary patterns of Mediterranean adolescents in Greece who participated in the Harokopio Nutrition Assessment Study (HNA). The objectives were to study food-group based consumption of adolescents, identify and compare eating patterns of male and female subjects including the types of foods and the times they were consumed, and compare these findings to research from other countries. Comparison of the diets of Greek adolescents with recommendations from both the USDA Food Guide Pyramid (FGP) as well as the Mediterranean Diet Pyramid (MD) were also studied.

Although approximately 35% of this population reported only light to sedentary activity levels, these findings were similar to findings from other countries. This population had a much greater incidence of smoking than other countries (Doyle & Hosfield, 2001; Wilson & Nietert, 2002). Interestingly, our data demonstrated that alcohol consumption was very low in this population; which was also seen by Bloomfield, et al., (2003).

Little has been done to date, to evaluate the eating habits or nutritional status of adolescents in Greece. To our knowledge, this is the only research obtained on food group-based consumption and dietary patterns of Greek adolescents. Based on our
findings, Greek adolescents no longer follow the traditional and healthful eating habits distinct to the Mediterranean region, as described by Dr. Ancel Keys (1986). Our adolescents population did not regularly meet the recommendations set by either the USDA FGP or the MD Pyramid. Neither males nor females met either the USDA FGP or the MD Pyramid recommendations for fruits or vegetables. They also significantly exceeded the USDA FGP recommendations for total meat-products and teaspoons of oil as well as the MD Pyramid recommendations for potatoes, sweets, and red meat. Additionally, they did not, however, meet the recommendations for fish and poultry set by the MD Pyramid. In regards to differences between sexes, males consumed significantly greater amounts of red meats, medium-fat meats, grains, and high fat foods including French fries, pizza, and burgers than females. Interestingly, fruit, alcohol, and meat-substitutes (legumes, eggs, nuts) consumption did not differ between sexes. Males also consumed significantly greater amounts of foods than females late in the evening (between 11:00 and 2:59am). Food patterns revealed two distinctive meal times: the first between 12:00 and 4:00 pm and the second between 8:00 and 11:00 pm. Only a fraction of this adolescent population consumed breakfast, which was composed of grains, milk, and coffee. As previously mentioned, late-night eating (11:00 – 2:59am) was also demonstrated by the time interval data, particularly in the males.

Vegetable consumption of adolescents was similar to the United States (Munoz, et al., 1997), but greater than consumption in the United Kingdom (Doyle & Hosfield, 2001), France (Volatier & Verger, 1999), Spain (Serra-Majem, et al., 2004), and younger Greek adolescents (Yannakoulia, et al., 2004a). Fruit consumption was similar to fruit consumption in the U.S. and U.K., but less than the other countries. Our population of
Greek adolescents consumed greater amounts of dairy than Spain, the U.S. and younger Greek adolescents as well as greater amounts of meat than the U.S., with similar amounts of meat consumption in French adolescents. They also consumed larger amounts of soda, sweets, and coffee than their younger counterparts. It is apparent that this adolescent population has abandoned the traditional MD to adopt a "western diet" that is high in meats, sweets, and fast-food; and low in unrefined grains, fruits and vegetables.

**Applications**

The effects of diet on disease and health are well documented. Poor dietary patterns can affect the progression of Cardiovascular Disease, Diabetes Mellitus, and different types of cancer. It is also understood that dietary patterns during childhood and adolescence, as well as the initiation and progression of chronic disease, can continue through adulthood. On the other hand, healthful eating patterns, as expressed in the MD, have been shown to offer protective effects against the degenerative diseases listed above. It is strongly advised that this population receive nutrition education regarding healthy food selection and the effects of diet on health, if rates of obesity, overweight, and chronic disease are to lessen in the future.

The MD was the traditional pattern of eating in this population. It was not a set standard for eating as the USDA FGP is, it was an expression of the eating patterns and lifestyle viewed in the 1950's by Dr. Ancel Keys and his colleagues (1986). With the introduction of high fat and high calorie foods and snacks into the market, selection of foods from the MD appear to have lessened. Unfortunately, as Serra-Majem, et al., (2004) conclude, sedentary lifestyles and the decreased time for preparation will not
change and therefore, modifications to the MD should be made to account for the changes, while still adhering to the recommendations for which its benefits have been documented. These include better understanding of portion sizes, label-reading, and promotion of reduced-fat and fat-free products over whole fat products. The use of olive oil as the main lipid is still of significant benefit; however, focus should be directed toward decreasing consumption of saturated and trans-fats from meats, pastries and sweets, and whole-fat dairy as well as education for their implications.

This population of Greek adolescents appears to be consuming very high amounts of meats, particularly red meats, as well as low amounts of fruits and vegetables. Servings of meats as well as vegetables, fruits, dairy, and grains should be demonstrated to the population to illustrate normal portion sizes. Label-reading is also a necessary skill in understanding nutrient content and percent fat in products and should be included in nutrition education. It is also useful in determining whether a grain product is a whole grain or whether it has undergone refining processes. Also, emphasis of a more vegetarian approach to eating, as expressed in the MD, should be encouraged. Results from the patterns of eating demonstrated that fruit and vegetable consumption was very low in the mornings. It may therefore be useful to promote these foods with breakfast and lunch in an effort to spread consumption throughout the day.

It is important to note that although adolescents may be eating on their own late at night, education of family members is also important since the adolescent population do not always prepare their own meals. Families should promote healthy eating habits such as eating breakfast and avoiding late-night meals and should offer fruits, vegetables, and whole grains for consumption at home, while limiting the purchase of high-fat and
It is hoped that the nutrition-related issues that have been uncovered from this research will be addressed by the Ministry of Education and the Hellenic Ministry of Public Health in modifying health curricula in primary and secondary education and educating physicians to increase awareness of healthier diet habits in the community. Additionally, dissemination of data through the media will raise public awareness of the dangers of poor diet habits in teenagers and their implications on increasing incidence of degenerative disease, as well as the social and economic impacts.
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APPENDIX A

The Mediterranean Diet

Figure A1. The Mediterranean Diet Pyramid.

Three day food diary

Each participant was required to record three consecutive days worth of eating: two week days and one weekend day. The following page illustrates the set up of a single day of the booklet (Table A1). Adolescents were required to record when they ate, what they ate, the name or brand of the food, the serving size, who prepared the food, where they ate the food, who they were with, doing while eating.
Table B1. Sample questionnaire of a 3-day food diary.

<table>
<thead>
<tr>
<th>Time</th>
<th>Description of food (Write down each food in a separate line)</th>
<th>Commercial name or brand name</th>
<th>Quantity that was consumed</th>
<th>Who prepared the food</th>
<th>Where did you eat? (for example: at home, school, on the go)</th>
<th>Who were you with?</th>
<th>What did you do while eating? (watching TV, studying, talking on the phone)</th>
</tr>
</thead>
<tbody>
<tr>
<td>7:30am</td>
<td>Whole milk</td>
<td>Delta</td>
<td>1 cup</td>
<td>I did</td>
<td>Home</td>
<td>Alone</td>
<td>Studying</td>
</tr>
<tr>
<td></td>
<td>Cornflakes</td>
<td>Kellog's</td>
<td>4 Tbsp</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>sugar</td>
<td></td>
<td>2 tsp</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11:45am</td>
<td>Cheese pie</td>
<td></td>
<td>1 medium-sized</td>
<td>Cafeteria</td>
<td>School</td>
<td>A friend</td>
<td></td>
</tr>
<tr>
<td>3:00pm</td>
<td>Spaghetti</td>
<td></td>
<td>2 cups</td>
<td>Grandma</td>
<td>Home</td>
<td>Grandma</td>
<td></td>
</tr>
<tr>
<td></td>
<td>butter</td>
<td></td>
<td>½ Tbsp</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Ground beef</td>
<td></td>
<td>2 Tbsp</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Grated cheese</td>
<td></td>
<td>2 Tbsp</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Raw carrot</td>
<td></td>
<td>1 medium</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5:00pm</td>
<td>Coffee</td>
<td>Nescafe</td>
<td>1 glass</td>
<td>I did</td>
<td>Home</td>
<td>Alone</td>
<td>Television</td>
</tr>
<tr>
<td></td>
<td>Condensed milk</td>
<td>Nou Nou</td>
<td>1 small portion</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Cake with almonds and chocolate</td>
<td></td>
<td>2 thin slices</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8:00pm</td>
<td>French fries</td>
<td>GOODY'S</td>
<td>1 portion</td>
<td>GOODY'S</td>
<td>Fast-food</td>
<td>A friend</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Cheeseburger</td>
<td>GOODY'S</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Soda (light)</td>
<td>Coca-cola</td>
<td>1 can</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12:00am</td>
<td>apple</td>
<td></td>
<td>1 medium</td>
<td>My father</td>
<td>Home</td>
<td>Alone</td>
<td>Television</td>
</tr>
<tr>
<td></td>
<td>orange</td>
<td></td>
<td>½ large</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
APPENDIX C

Sample portion sizes

Aside from the three day food diary, participants were required to fill out a Food Frequency Questionnaire directed toward typical foods consumed in Greece which included 153 different food items. Sample data from the questionnaire can be viewed on the following pages.

Pictures of different portions sizes of each food were placed next to each other and labeled with an alpha (A), beta (B), gamma (Γ), or delta (Δ) depending upon the size of the serving. An alpha-sized portion was equivalent to the smallest sized portion and the delta portion was equivalent to the largest sized portion.

Although food frequency data was not evaluated in this study, these pictures were used as reference tools by the Dietitians when there were questions or discrepancies in assessing portion sizes from the 3-day food diary. Therefore, some portions were described using these references; for example, a beta portion of cheese pie or a gamma portion of French fries.
Figure C1. Food Frequency representations of sample serving sizes of fried anchovies.

Figure C2. Food Frequency representations of sample serving sizes of French fries.
Figure C3. Food Frequency representations of sample serving sizes of spaghetti.

Figure C4. Food Frequency representations of sample serving sizes of cheese pie.
Figure C5. Food Frequency representations of sample serving sizes of pastitsio.
APPENDIX D

Evaluation of components of prepared and/or mixed foods

Table A2 lists common foods consumed by this population and how they were disassembled into basic food groups. This list was composed as a standard of reference to help maintain consistency throughout the data. To evaluate composition of traditional foods including pastitsio and cheese pie, a traditional Greek recipe book was used and total ingredients were evaluated and divided by the approximate number of servings (as expressed in the recipe for each individual serving). The FGP handout (USDA, Center for Nutrition Policy and Promotion, 1996) was used as a standard to evaluate composition of some foods including average teaspoons of butter and sugar in sweets and number of grain servings in some products.

Reported serving data were then compared with these above standards to maintain consistency throughout the data. Estimated amounts were then entered into SPSS. For example, if a participant reported “1 large croissant”, it was estimated that this portion would be larger than a typical croissant and would therefore be entered as “1.5 croissant and 1.5 teaspoons sugar”.

When the diaries were retrieved at the end of the study, a Dietitian worked with each participant to better clarify their data. Food frequency questionnaire pictures were used as references and therefore some of the data had portion sizes (A, B, C, ... ) written in next to them. To better evaluate the sizes and create a more accurate break-down of the food, the picture was then used as a reference. With pastitsio as an example, an alpha portion would be considered half a portion and would therefore be equivalent to half of
the standard below. A beta portion was equivalent to one serving and was therefore equivalent to the entire standard. A gamma portion was equivalent to one and a half servings and a delta portion was equivalent to 2 servings.
Table D1. Exchange equivalents for components of prepared and/or mixed foods.

<table>
<thead>
<tr>
<th>Food Group</th>
<th>Exchange equivalent</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Grains</strong></td>
<td></td>
</tr>
<tr>
<td>Cereal (1 oz or 1 cup)</td>
<td>1 grain, sugar dependant upon brand</td>
</tr>
<tr>
<td>Croissant</td>
<td>1 croissant, 1 t sugar</td>
</tr>
<tr>
<td>Pita bread 1 large</td>
<td>2 grain</td>
</tr>
<tr>
<td>1 average</td>
<td>1.5 grain</td>
</tr>
<tr>
<td>1 small</td>
<td>1 grain</td>
</tr>
<tr>
<td>Sub (from sandwiches)</td>
<td>3 grain</td>
</tr>
<tr>
<td>Tsoureki 1 slice (30 g)</td>
<td>1 grain, 1/2 t sugar</td>
</tr>
<tr>
<td><strong>Vegetables</strong></td>
<td></td>
</tr>
<tr>
<td>Carrot salad (1/2 cup)</td>
<td>1 veggie, 2 t oil</td>
</tr>
<tr>
<td>Green beans w/ tomato</td>
<td>2 veggie, 3 t oil</td>
</tr>
<tr>
<td>sauce (1 cup)</td>
<td></td>
</tr>
<tr>
<td>Potato 1 medium</td>
<td>1 veggie, 1 potato</td>
</tr>
<tr>
<td>French fries (10)</td>
<td>1 veggie, 1 French fry, 3 t oil</td>
</tr>
<tr>
<td>Tomato salad (1 cup)</td>
<td>2 vegetables, 6 t oil</td>
</tr>
<tr>
<td><strong>Meats</strong></td>
<td></td>
</tr>
<tr>
<td>Bacon (1 slice)</td>
<td>0.8 oz high fat meat, 0.8 oz red meat, 1/3 t oil</td>
</tr>
<tr>
<td>Chicken leg</td>
<td>3 oz lean meat, 3 oz red meat</td>
</tr>
<tr>
<td>Chicken patty</td>
<td>3 oz lean meat, 3 oz red meat</td>
</tr>
</tbody>
</table>
Table D1. continued

<table>
<thead>
<tr>
<th>Food Group</th>
<th>Exchange equivalent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fried anchovies</td>
<td>4 oz medium-fat meat, 4 oz fish, 2 t oil</td>
</tr>
<tr>
<td>(alpha portion)</td>
<td></td>
</tr>
<tr>
<td>Fried egg 1</td>
<td>1 egg, 1 oz meat sub, ½ t oil</td>
</tr>
<tr>
<td>Legumes (½ cup cooked)</td>
<td>1 legume, 2 oz meat sub</td>
</tr>
</tbody>
</table>

Entrees and sides

<table>
<thead>
<tr>
<th>Entree</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bolognese sauce (½ cup)</td>
<td>2.5 oz medium-fat meat, 2.5 oz red meat, 4 t oil,</td>
</tr>
<tr>
<td></td>
<td>½ veggie</td>
</tr>
<tr>
<td>Cheese pie (1/10 recipe)</td>
<td>1 cheese, 7 t butter, ½ egg, ½ oz meat sub, 1.5 grain</td>
</tr>
<tr>
<td>Cheese pie w/ spinach (1/10 recipe)</td>
<td>1 cheese, 1 veggie, 1/5 egg, 1.5 grain, 5.5 t oil</td>
</tr>
<tr>
<td>Grape leaves (10)</td>
<td>5 t oil, 1 grain, 1 oz red meat, 1 oz medium-fat meat, ½ veggie</td>
</tr>
<tr>
<td>Lentil/chick pea soup (1 cup)</td>
<td>1 legume, 6 t oil, 2 oz meat sub</td>
</tr>
<tr>
<td>Lima bean stew (1 cup)</td>
<td>1 legume, 1 veggie, 6 tsp oil, 2 oz meat sub</td>
</tr>
<tr>
<td>Meat pie (1/10 recipe)</td>
<td>1 2/3 oz medium-fat meat, 1 2/3 oz red meat, 1.5 grain, 5.5 t butter, ½ egg</td>
</tr>
<tr>
<td>Pasta and tomato sauce (1 cup)</td>
<td>1.5 grain, 1 veggie, 6 t oil</td>
</tr>
</tbody>
</table>
Table D1. continued

<table>
<thead>
<tr>
<th>Food Group</th>
<th>Exchange equivalent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pastitsio (1/8 recipe)</td>
<td>1.5 grain, 2 oz medium-fat meat, 2 oz red meat,</td>
</tr>
<tr>
<td></td>
<td>1 veggie, 3 t oil, 3 t butter, 1/2 milk, 1 egg,</td>
</tr>
<tr>
<td></td>
<td>1 oz meat sub, 1 cheese</td>
</tr>
<tr>
<td>Spanikopita (1/10 recipe)</td>
<td>5.5 t olive oil, 3.5 t butter, 1 veggie, 1.5 grain</td>
</tr>
<tr>
<td>Tortellini w/ cheese (1 cup)</td>
<td>1.5 grain, 1 cheese</td>
</tr>
</tbody>
</table>

**Fast foods**

| Cheesburger (1 small)                  | 2 grain, 2 oz medium-fat meat, 2 oz red meat, 2/3 cheese |
| French fries (10)                      | 1 Total veggie, 1 French fry, 3 t oil                   |
| 1 McDonald’s portion                   | 2 Total veggie, 2 French fry, 3 t oil                   |
| Hamburger (1 small)                    | 2 grain, 2 oz medium meat, 2 oz red meat               |
| Pizza (1/8 medium)                     | 1 grain, 2/3 cheese, 1/4 veggie                        |
| Souvlaki w/ meat                       | 1.5 grain, 3 oz medium-meat, 3 oz red meat, 2/3 veggie, 6 t oil |

**Sweets**

| Baklava (2 x 2")                      | 1 cake, 3 t sugar, 1/2 nuts, 3 t butter                |
| Biscotti (2 medium)                    | 2 cookie, 1 t sugar                                    |
| Cake w/ icing (2 x 2")                | 1 cake, 6 t sugar, 3 t butter                          |
| Cake w/o icing (2 x 2")               | 1 cake, 2 t sugar, 3 t butter                          |
Table D1. continued

<table>
<thead>
<tr>
<th>Food Group</th>
<th>Exchange equivalent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cake (angel food) (2 x 2&quot;)</td>
<td>1 cake, 5 t sugar</td>
</tr>
<tr>
<td>Chocolate bar</td>
<td>1 chocolate, 3 t sugar</td>
</tr>
<tr>
<td>Chocolate truffles (3)</td>
<td>1 chocolate, 3 t sugar</td>
</tr>
<tr>
<td>Ice cream cone</td>
<td>1 cookie, 6 t sugar, ¼ milk, 1 ½ ice cream</td>
</tr>
<tr>
<td>Ice cream (½ cup)</td>
<td>½ milk, 3 t sugar, 1 ice cream</td>
</tr>
<tr>
<td>Oreo cookies (2)</td>
<td>2 cookies, 2 t sugar</td>
</tr>
<tr>
<td>Sugar, jam, honey, syrup,</td>
<td>1 t sugar/ tsp item</td>
</tr>
<tr>
<td>Sukafreta</td>
<td>2 chocolate, 6 t sugar</td>
</tr>
</tbody>
</table>

**Beverages**

<table>
<thead>
<tr>
<th>Beverages</th>
<th>Exchange equivalent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mixed drink (8 oz)</td>
<td>1 alcohol, 3/4 fruit, or 1 alcohol, 2/3 soda, 6 t sugar</td>
</tr>
<tr>
<td>Soda (8 oz)</td>
<td>6 t sugar, 1 soda</td>
</tr>
</tbody>
</table>
APPENDIX E

Additional food consumption pattern data

According to Figures E1 and E2, potato consumption and percent population trends followed the normal trend (as described previously) and was significantly greater in males than females during time 3 (12:00 – 3:59pm). Potato consumption in the evening was not significantly different between males and females, nor was the percent of population consuming potatoes during any interval.

Figures E3 and E4 demonstrate average lean meat consumption and the percent population consuming lean meat throughout the day. The trend followed the normal curve, however females consumed slightly (not significantly) greater amounts of lean meats during time 3 (12:00 – 3:59pm) than males and then the trend flipped showing that males consumed significantly greater amounts of lean meats during times 5 (8:00 – 10:59pm) and 6 (11:00 – 2:59am). A very similar trend is apparent from the percent of population data. Nearly 6% more females consumed lean meats during the mid-day meal than males and nearly 5% of males consumed more lean meats during the evening meal.

Although medium-fat meats were significantly different between males and females from time 3 through time 6, these data were nearly identical to the trend seen in red meats which is most likely due to the fact that most red meats were medium-fat meats (Figures E5 and E6). Overall, the pattern for medium-fat meats followed the normal curve for both average ounces per time as well as percentage of population.
Figure E1. Average servings of potatoes by time.

Figure E2. Percent of population consuming potatoes during the day.
Figure E3. Average ounces of lean meats by time.

*Statistically significant at each time interval at p ≤ 0.05

Figure E4. Percent of population consuming lean meats during the day.
Figure E5. Average ounces of medium-fat meats by time.

Time intervals

*Statistically significant at each time interval at p ≤ 0.05
**Statistically significant at each time interval at p ≤ 0.01

Figure E6. Percent of population consuming medium-fat meats during the day.

Time intervals
High-fat meats did not follow the normal curve with servings being consumed during the morning; however, average amounts were very low with a peak in males during time 3 of only 0.11 ounces (Figures E7 and E8). Although the chart depicts that males consumed more high-fat meats than females, none of the time interval data were significantly different.

Average means and percent population figures for meat-substitutes (nuts, eggs, legumes, and total meat-substitutes) by time can be viewed in Figures E9 through E16. As can be viewed in E9, average servings of nuts was very low, with males peaking during time 4 (4:00 – 7:59pm) at only 0.1 servings and female consumption not exceeding 0.03 servings at any time interval. Although males appear to have consumed more servings of nuts during times 4 and 5 (8:00 – 11:59pm), these amounts were not significant. Figure E10 demonstrates that the percentage of population consuming nuts was greater in the evening than the morning or afternoon, however males peaked at only 4% during time 5. Overall, none of the data were significant.

Average egg consumption (Figure E11) peaked for both males and females during time 3 (12:00 – 3:59). A similar trend can be viewed in the percentage of population figure (Figure E12), except for a mildly greater slope between times 1 (6:00 – 8:59am) and 3 (12:00 – 3:59pm) suggesting that while less was consumed, more persons consumed them. Although the percent of population consuming eggs peaked at 14% for males and 12% for females during time 3, average serving size was only 0.19 and 0.13, respectively.
Figure E7. Average ounces of high-fat meats by time.

Figure E8. Percent of population consuming high-fat meats during the day.
Figure E9. Average servings of nuts by time.

Figure E10. Percent of population consuming nuts during the day.
Figure E11. Average servings of eggs by time.

![Graph showing average servings of eggs by time for males and females.]

Figure E12. Percent of population consuming eggs during the day.

![Graph showing percent of population consuming eggs by time for males and females.]

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As demonstrated in Figure E13, average legume consumption followed the normal trend and was less than 0.09 servings for males and 0.07 servings for females at their respective peaks during time 3 (12:00 – 3:59pm). Absolutely no legumes were consumed during time 1 (6:00 – 8:59am) by males or females, and none were consumed during time 4 (4:00 – 7:59pm) by females. Also, no more than 7% of males and 5.5% of females consumed legumes at any time interval during the day (Figure E14).

Even when total meat-substitutes were combined, Figure E15 demonstrates that very little were consumed on average by either males or females throughout the day. As illustrated from the previous meat-substitutes figures, most were consumed during the mid-day meal versus the evening meal. Males and females peaked during time 3 (12:00 – 3:59pm) at less than 0.25 servings and 0.23 servings, respectively. Figure E16 shows that similar percentages of males and females consumed total servings of meat-substitutes throughout the day.
Figure E13. Average servings of legumes by time.

![Average servings of legumes by time](image)

Figure E14. Percent of population consuming legumes during the day.

![Percent of population consuming legumes during the day](image)
Figure E15. Average servings of meat-substitutes by time.

Figure E16. Percent of population consuming meat-substitutes during the day.
BIOGRAPHY OF THE AUTHOR

Sandra Ellan Brussee hails from Ridge, New York on Long Island and was born on September 24, 1981. She graduated from Longwood Senior High School in 1999. She knew early on that she wanted to find a career in Dietetics and therefore attended the State University of New York at Plattsburgh where she was awarded a Bachelor’s of Science in Nutrition and Dietetics in 2003. She was then accepted into the combination Dietetic Internship and Master’s program at The University of Maine in Orono where she completed her Dietetic Internship.

After receiving her degree, Sandra plans on moving back to New York, getting married, and finding a job in Dietetics at one of the surrounding hospitals. Her long-term dream is to own and manage a health and wellness center in Saratoga, New York.

Sandra is a candidate for the Master of Science degree in Food Science and Human Nutrition from The University of Maine in August 2005.