

Beliefs, benefits, barriers, attitude, intake and knowledge about peanuts and tree nuts among WIC participants in eastern North Carolina

Roman Pawlak^{1§}, Sarah Colby² and Julia Herring³

¹Department of Nutrition and Dietetics, East Carolina University, 337 Rivers West Building, Greenville, NC 27858, USA

²Department of Nutrition and Dietetics, East Carolina University, Rivers West 333, Greenville, NC 27858, USA

³Department of Cumberland County Health, Nutritionist, Women, Infant, and Children (WIC) Program, 227 Fountainhead Ln Fayetteville, NC 28301, USA

Received May 4, 2009; Revised September 10, 2009; Accepted September 14, 2009

Abstract

The objective of this study was to assess beliefs (e.g. advantages, disadvantages, benefits, barriers) and knowledge about eating peanuts and tree nuts. Personal interviews based on the Theory of Planned Behavior were conducted to elicit beliefs about eating nuts. Then, a cross-sectional survey was administered to WIC participants from one county in North Carolina. One-hundred-twenty-four WIC participants (mean (SD) age=28.39 (8.09) completed the study. Most were Caucasian (51.6%) females (96%). About one third believed that eating nuts may help to lower cholesterol level. However, only about one forth believed that nuts can lower a risk of a heart attack or diabetes. More than one third believed that eating nuts will cause weight gain. The knowledge of respondents' about nutrient content of nuts was low with correct answers to most questions about 20% or below. The mean (SD) positive attitude, negative attitude, benefits and barriers scores, based on a range from 1 to 5, were 2.53 (0.91), 3.25 (0.89), 2.97 (0.85) and 2.90 (0.76), respectively. WIC participants' beliefs regarding the health effects of nuts are inconsistent with the most recent research findings. They are in a need to education about benefits of eating nuts.

Key Words: Nuts, WIC, barriers, beliefs, knowledge

Introduction

Studies conducted in the past two decades showed that both peanuts and tree nuts protect against heart disease including the development of and mortality from coronary heart disease, fatal and non-fatal ischemic heart disease, and sudden cardiac death. For example, Albert *et al.* (2002) showed that male health professionals (n=21,454) who ate nuts two or more times per week had a 0.53 relative risk for sudden cardiac death when compared with males who rarely or never ate nuts. Jenkins *et al.* (2002) reported that hyperlipidemic men and women (n=27) who ate 73grams of almonds per day for a month decreased the LDL cholesterol by about 9% thus reducing their risk for coronary heart disease by about 18%. A pooled analysis of four epidemiologic studies showed that those with the highest intake of nuts had a 35% reduced risk for coronary heart disease (Kris-Etherton *et al.*, 2008).

The protective effect of nuts on diseases of the heart and vessels is believed to be attributed to several factors. High intake of nuts is consistently shown to reduce total and LDL-cholesterol level and may also increase HDL level (Curb *et al.*, 2000; Garg *et al.*, 2007; Gebauer *et al.*, 2008). It has also been shown that

increased intake of nuts can reduce oxidative stress, reduce inflammation and improve vascular endothelial function (Cortes *et al.*, 2006; Davis *et al.*, 2007; Jiang *et al.*, 2006). Nuts contain relatively high amounts of fat. Most nuts are high in monounsaturated fat, however, walnuts are high in polyunsaturated fats. Walnuts and peanuts are considered good sources of alpha-linolenic acid. Nuts are also good sources of protein, fiber and some micronutrients including folate, magnesium, potassium and copper. They are also a good source of phytosterols such as stigmasterol, campesterol, and sitosterol (Coates & Howe, 2007). In addition, peanuts are considered good sources of polyphenols such as catechins, porcyanides, and resveratrol (Kris-Etherton *et al.*, 2008).

Studies also showed that nuts may protect against diabetes, blood pressure, metabolic syndrome, and may be helpful in management weight (Bes-Rastrollo *et al.*, 2007; Jiang *et al.*, 2002; Mackenbach *et al.*, 2008; Mukuddem- Peterson *et al.*, 2007; Salas-Salvado *et al.*, 2008). Jiang and colleagues found that women who consumed nuts five or more times per week had a lower risk of type-2 diabetes (almost 30% less) compare to those who never or almost never ate nuts. Bes-Rastrollo and colleagues found that people who consumed nuts two or more

§ Corresponding Author: Roman Pawlak, Tel. 1-252-328-2350, Fax. 1-252-328-4276, Email. pawlakr@ecu.edu

times a week had a 0.69 lower odds ratio of risk of weight gain than individuals who never or almost never ate nuts.

Previously, individuals and health professionals believed that because nuts are high in fat they, at best, should be consumed sparingly. In spite of several dozen randomized, prospective and case-control studies conducted over the past 20 years, that showed the health benefits of eating nuts, no study to date has been published about individuals' perception of eating nuts. Thus, it is unknown whether any of the new scientific findings about benefits of eating nuts have been translated to individuals' knowledge and perception of eating nuts.

Individuals with low socioeconomic status, especially those from rural communities have higher rates of mortality from chronic health conditions such as cardiovascular diseases (Berkman & Epstein 2008; Mackenbach *et al.*, 2008). Thus, promoting intake of nuts with low income individuals may be especially important. Currently it is unknown if low income individuals are aware of the health benefits associated with nut consumption, how they perceive nuts, and how often they consume nuts. Thus, the goal of this study was to assess perceptions of eating nuts among participants of WIC program from one county in North Carolina. The specific objectives included: 1) to assess beliefs (e.g. benefits, barriers, beliefs about nutrient content, beliefs about nuts and disease prevention linkage); 2) to assess knowledge regarding nutrient content and disease prevention linkage; and 3) to assess intake of nuts.

Subjects and Methods

Subjects

A cross-sectional survey was administered to participants of WIC program from one county in North Carolina. Before data collection took place, the study protocol was submitted and approved by the Institutional Review Board at East Carolina University.

Survey development

The development of the survey followed the following steps:

1. Personal interviews with WIC participants to elicit beliefs about nut consumption
2. Creating knowledge statements based on the most current literature
3. Creating a food frequency questionnaire about intake of nuts
4. Survey validation

Personal Interviews

The first step in the survey development consisted of conducting personal interviews with randomly selected WIC clients. The purpose for the interviews was to elicit important

beliefs (e.g. advantages, disadvantages, benefits, barriers) about eating nuts. For that purpose, the interviewees were asked eight questions based on the Theory of Planned Behavior. For example, participants were asked "*What do you think would be good about eating nuts on all or most days of the week?*" or "*What things would make it harder for you to eat nuts more often?*" to elicit benefits and barriers, respectively.

A total of 15 interviews were conducted over three business days with randomly selected WIC clients. All personal interviews were conducted by a nutritionist who worked at a WIC office. The interviews were given after the clients' scheduled WIC appointment in the nutritionist's cubicle. All 15 clients who participated in the personal interviews were females and had an average age of 23.9 years old (range 18 to 42). African Americans made up the majority of the individuals interviewed (n=7).

Each person interviewed was informed about the protocol of the study prior to the interview. Participants were either WIC participants (n=7) or guardians of children that are on the WIC program (n=8). The answers to the questions were written down by the interviewer.

Two researchers independently analyzed all elicited answers. Participants identified 45 different beliefs about eating nuts. Fifteen most frequently listed beliefs were included in the survey. For example, beliefs that nuts "are healthy," "were filling and made you full" and "are high in protein". The most frequently listed disadvantages included "nuts are fattening," "are bad for your cholesterol" and "are high in salt." The most frequently given answer to the question "*What things would help you to eat nuts more often?*" included better flavor, more available and more affordable. Family members (e.g. spouse, children) were identified as the most important individuals that influenced respondents' nut intake.

Food frequency questionnaire

The same participants who participated in personal interviews were also asked to complete a food frequency questionnaire and a 24-hour dietary recall for the purpose of FFQ validation. The survey was created using the Harvard Food Frequency Questionnaire as a format reference. Sixteen types of nuts, seeds or nut product (e.g. peanut butter) were included on the FFQ. These included almonds, pecans, macadamia nuts, cashews, hazelnuts, sunflower seeds, walnuts, peanuts, peanut butter, pumpkin seeds, flax seeds, Brazil nuts, pine nuts, pistachios, sesame seeds, other nuts, and other seeds. If respondents indicated that they did consume other nuts or other seeds they were asked to also indicate what type of other nuts or other seeds were consumed. No descriptions of serving sizes were included on the FFQ. The FFQ questions asked "how often do you eat..." with frequency options of never, 1-6 times a year, 7-11 times a year, 1 time a month, 2-3 times per month, 1 time per week, 2 times per week, 3-4 times per week, 5-6 times per week, 1 time per day, or 2 or more times per day.

Survey Validation

The final survey included eight belief (Chronbach alpha=0.779), five positive (Chronbach alpha=0.849), five negative attitude (Chronbach alpha=0.746), eight benefit (Chronbach alpha=0.884), nine barrier (Chronbach alpha=0.846) and five knowledge statements (Chronbach alpha=0.679) about eating nuts. The statements regarding attitude, benefits, and barriers were scored on a Likert scale rated 1-strongly agree, 2-agree, 3-neither, 4-disagree, 5 strongly disagree. Each of these statements referred to barriers, benefits or attitude toward eating nuts on “most days of a week.”

The belief statements included *Yes*, *No* and *I don't know* answers. All knowledge questions were multiple-choice questions with four to eight options to select the correct answer from.

Data collection

Once the survey was developed it was administered to WIC participants at one site located in Cumberland County, North Carolina. The survey was administered by a staff member. All WIC participants who came for their regular appointment were asked to participate.

Results

Surveys results

Out of the 180 WIC clients who were asked to participate, 141 agreed and completed the survey. Seventeen surveys were

excluded from analysis because they contained blank questions. Thus, 124 surveys were included in the analysis.

Demographic

The mean age of the participants was 28.39 (SD 8.09), and the age ranged from 18 to 62. The majority of participants (119 of 124 or 96%) were females. Caucasian participants comprised the majority of clients (64 of 124 or 51.6%), followed by 46 (37.1%) African Americans. See Table 1 for additional demographic information.

Findings

Intake of nuts

Eighty-six percent of participants reported not eating nuts on a daily basis, 7% reported eating nuts on average one time a

Table 1. Study sample characteristics (n=124).

Socio-demographic characteristics	N	%	Valid %
Age			
Mean (SD)=28.39 (8.1)			
Gender			
Males	5	4.0	4.0
Females	119	96.0	96.0
Ethnic background			
African American	46	37.1	37.7
Caucasian	64	51.6	52.5
Hispanic	5	4.0	4.1
Asian	2	1.6	1.6
Other	5	4.0	4.1
Missing	2	1.6	
Income (\$)			
< 10,000	43	34.7	36.1
10,001-20,000	24	19.4	20.2
20,001-35,000	36	29.0	30.3
35,001-50,000	10	8.1	8.4
50,001-65,000	5	4.0	4.2
65,001-85,000	1	0.8	0.8
Missing	5	4.0	

Table 2. Beliefs regarding nutrient content and health effect of nuts

Statements	True %	False %	I don't know %
Nuts are high in calories	42.6	18.0	39.3
Nuts are high in fat	49.2	20.5	30.3
Nuts are high in dietary fiber	49.6	8.3	42.1
Nuts are high in salt	56.3	24.4	19.3
Eating nuts may help to lower cholesterol level	32.8	13.1	54.1
Eating nuts may help to lower a risk for a heart attack	26.4	14.0	59.5
Eating nuts may help to lower a risk for diabetes	26.2	12.3	61.5
Eating nuts will cause weight gain	37.0	32.8	30.3

Table 3. Mean (SD) scores of statements regarding attitude toward eating nuts on most days of a week

Positive/negative attitude statements	Mean (SD)*
Positive attitude	2.53 (0.91)
I should eat nuts on most days of a week because nuts are healthy	2.44 (1.13)
I should eat nuts on most days of a week because they are high in iron	2.48 (1.08)
I should eat nuts on most days of a week because they are high in protein	2.24 (1.07)
I should eat nuts on most days of a week because they are filling	3.00 (1.34)
I should eat nuts on most days of a week because they are a good source of omega-3 fat	2.46 (1.14)
Negative attitude	3.25 (0.89)
I should not eat nuts on most days of a week because they are high in fat	3.28 (1.20)
I should not eat nuts on most days of a week because they are high in salt	2.85 (1.29)
I should not eat nuts on most days of a week because they would cause my cholesterol to increase	3.11 (1.16)
I should not eat nuts on most days of a week because I would gain weight	3.37 (1.31)
I should not eat nuts on most days of a week because nuts cause allergies	3.62 (1.34)

* standard deviation

day, and 7% reported eating nuts two or more times a day. Only nine participants (7.3%) ate nuts on 5 or more days a week.

Beliefs

About one third of participants (32.8%) believed that eating nuts may help to lower cholesterol level and more than half did not know the effect of eating nuts on cholesterol. However, only about 25% of people believed that nuts can lower a risk of a heart attack or diabetes and about 60% were not aware of the impact of nuts on heart disease or diabetes. More than one third (37%) believed that eating nuts would cause weight gain and close to one third did not know what the effect of eating nuts on weight status would be. More than half (54%) believed that nuts were high in salt and close to 50% believed that nuts were high in fat and fiber. Forty percent indicated that nuts were high in calories.

Attitude

From the 10 statements included in these two variables “*I should eat nuts on most days of a week because they are healthy*” received the strongest agreement (mean=2.47), with 1 indicating strongly agree and 5 indicating strongly disagree, whereas “*I should not eat nuts on most days of a week because nuts cause allergies*” received the strongest disagreement (mean=3.62). Also, 28.5% of respondents either agreed or strongly agreed with the statement “*I should not eat nuts on most days of a week because they would cause my cholesterol to increase*” (Table 3). Table 3 contains scores for each statement included in these two variables.

Benefits and barriers

From the 17 benefits and barriers statements included in the survey, the statement “*I would eat nuts on most days of a week if my doctor recommended me to do so*” received the strongest agreement (mean=2.11, with 1 indicating strongly agree and 5 indicating strongly disagree), whereas “*I would eat nuts on most days of a week if they were lower in calories*” received the strongest disagreement (mean=3.74). Other important benefits related to nuts intake included obtaining nutrients and dietary fiber. Affordability was identified as a barrier to eating nuts (Table 4). Chi square analysis revealed that those who ate nuts more often were more likely to believe that eating nuts on most days of the week would help them be healthier ($\chi^2(2, 124)=7.31, P < 0.05$)

Knowledge

Generally, the knowledge of respondents’ about nutrient content of nuts was low. Out of possible 100% of correct answers, the score of correctly answered questions was 20% or below for

Table 4. Mean (SD)* scores for benefits and barriers to eat nuts

Benefit and barrier statements	Mean (SD)*
Benefits	2.97 (0.85)
Eating nuts on most day of a week would help me feel better	3.15 (1.19)
Eating nuts on most days of a week would help me to take better care of my body	3.07 (1.19)
Eating nuts on most days of a week would help me get more nutrients	2.59 (1.11)
Eating nuts on most days of a week would help me be healthier	2.69 (1.06)
Eating nuts on most days of a week would give me the energy I need	2.79 (1.10)
Eating nuts on most days of a week would help me to eat more fiber	2.66 (1.06)
Eating nuts on most days of a week would help me to look young	3.54 (1.24)
Eating nuts on most days of a week would be consistent with the advice of my doctor	3.24 (1.23)
Barriers	2.90 (0.76)
Eating nuts on most days of a week would cost me too much money	2.98 (1.40)
Eating nuts on most days of a week would cause me to eat too much fat	3.05 (1.18)
Eating nuts on most days of a week would cause me to eat too many calories	3.00 (1.16)
I would eat nuts on most days of a week if they were available in grocery stores where I go shopping	3.21 (1.39)
I would eat nuts on most days of a week if they were affordable	2.59 (1.24)
I would eat nuts on most days of a week if they had more flavor	3.37 (1.20)
I would eat nuts on most days of a week if they were lower in fat	2.86 (1.19)
I would eat nuts on most days of a week if they were lower in calories	3.74 (1.18)
I would eat nuts on most days of a week if my doctor recommended me to do so	2.11 (1.12)

* standard deviation

Table 5. Percent of correctly answered knowledge questions

Questions	Correct answers (%)
Which of the following is the most predominant fat (most abounded) found in nuts such as almonds, pecans, macadamia nuts, cashews and hazelnuts?	11.6
Which of the following is the most predominant fat found in walnuts?	5.1
Peanuts and walnuts are considered a good source of which of the following fats?	78
Which of the following nuts have the highest content of omega-3 fatty acids?	20.7
Which of the following nuts have the highest content of selenium?	20.4

most questions. However, 78% of the participants correctly answered a question regarding which nut was the richest source of omega-3 fatty acids. Table 5 contains scores for all knowledge questions.

Discussion

Recent randomized, prospective and case-control studies showed that frequent consumption of most nuts help to protect

against incidence of and mortality from heart disease, blood pressure, metabolic syndrome, diabetes, and can lower cholesterol, and weight (Albert *et al.*, 2002; Bes-Rastrollo *et al.*, 2007; Cortes *et al.*, 2006; Curb *et al.*, 2000; Davis *et al.*, 2007; Garg *et al.*, 2007; Gebauer *et al.*, 2008; Jenkins *et al.*, 2002; Jiang *et al.*, 2002; Jiang *et al.*, 2006; Kris-Etherton *et al.*, 2008; Mackenbach *et al.*, 2008; Mukuddem- Peterson *et al.*, 2007; Sabate *et al.*, 1993; Salas-Salvado *et al.*, 2008) The Loma Linda University electronic database, the most comprehensive database of published manuscripts on nuts, lists 147 manuscripts published between 1991 to 2008 about nuts. However, not one manuscript listed described research regarding the perceptions (e.g. beliefs, benefits, barriers) of eating nuts among individuals or individuals with low incomes (who are at a higher risk for developing many chronic diseases) for which nut consumption may be especially beneficial. Thus, this research fills an important gap in the literature because it describes beliefs of low income (high disease risk) individuals about their knowledge, beliefs, and perceptions about health impact of eating nuts.

The results of this study indicated that the beliefs of low income respondents in this study were somewhat inconsistent with the most recent scientific knowledge about the health aspect of nuts. For example, only about one third of participants believed that nuts have cholesterol-lowering effect and only about one fourth knew that nuts can lower risk for a coronary heart disease. Furthermore, close to 30% either agreed or strongly agreed with a statement that they should not eat nuts because nuts may increase their cholesterol level. Only about 30% were agreed with a statement that the FDA had approved a health claim that nuts intake may reduce cholesterol and a risk for heart disease and about 63% were not aware of this health claim. Furthermore, one of the most frequently listed beliefs identified in the personal interviews was that nuts intake may cause an increase in cholesterol. Considering the cholesterol-lowering effect shown by many recent studies, these findings are rather disappointing and represent a nutrition education opportunities. It may be interesting to point out that the majority (78%) of respondents were aware that walnuts are a good source of omega-3 fatty acids. Yet, only a fraction of respondents believed that nuts in general may help to lower the risk for a heart attack. These findings may indicate that the participants may not be aware of the benefits of omega-3 fatty acids on coronary heart disease.

Approximately one quarter of participants were aware that eating nuts may help to lower one's risk for diabetes and a similar number knew that nuts may help to lower blood pressure. Furthermore, 37% percent of the participants felt that eating nuts would cause weight gain even though studies do not support this conclusion. Research does not indicate that eating nuts causes weight gain (Bes-Rastrollo *et al.*, 2007; Sabate, 2003). The findings of this research indicate inadequate knowledge of respondents regarding the protective aspect of nuts on diabetes. Thus, in spite of almost two decades of research showing that nuts are important foods to include in a healthy diet, it appears

that the general public may not be aware of this relationship between nuts and health.

From the 27 statements included in the positive attitude, negative attitude, benefits and barriers variables "*I would eat nuts on most days of a week if my doctor recommended me to do so*" received the strongest agreement (mean=2.11, with 1 indicating strongly agree and 5 indicating strongly disagree). This reveals that physicians can play a very important role in changing patients' knowledge and beliefs about the health benefits of nuts and thus increase nut intakes.

"I would eat nuts on most days of a week if they were lower in calories" received the strongest disagreement (mean=3.74, with 1 indicating strongly agree and 5 indicating strongly disagree), which shows that the high caloric content of nuts is not a factor in whether people would eat nuts or not. Almost 50% of respondents either agreed or strongly agreed that they would eat nuts if they were affordable. Affordability is also a barrier for eating other healthy items such as fruits and vegetables. This finding may have a very practical policy implication for WIC participants. Currently, only peanut butter is offered to WIC participants. Since nuts, including raw nuts are commonly available in most grocery stores, one possible way to increase nuts intake among WIC participants would be to add raw nuts, mixed nuts and other nuts to the foods lists approved for WIC clients. Since many WIC participants are at some type of nutritional risk due to either nutrient deficiency or due to their weight status (a risk factor for heart disease and diabetes from which nuts are protective against), adding nuts to a list of foods included on WIC vouchers may be cost effective and relatively simple way to improve the health status of WIC clients.

Close to 30% of respondents indicated that they would eat nuts if they were available in grocery stores where they go grocery shopping. Although this finding indicates that the majority of respondents have access to and can obtain nuts from stores, the vast majority of respondents' intake of nuts was negligible. This finding may strengthen the suggestion that making nuts available on WIC vouchers could help in higher intake of nuts and thus contribute to the primary prevention of many chronic diseases.

Respondents had low levels of nutrition knowledge regarding nuts. For example, only 11% of respondents correctly answered the question on the fat content of nuts. About 40% of respondents believed that saturated fat was the predominant fat found in most nuts. Thus, efforts should be made to educate people about the beneficial profile of the fat content in nuts.

Although this research fills an important gap in studies on nuts, the results should be interpreted in view of some limitations. Data was collected from just one WIC site in one state located in the south of the U.S. Also, the results are based on a convenience sample in which the majority of respondents were females. Thus, the results are mostly applicable to females and are not representative of the entire U.S. WIC population or the general public.

Recent studies showed a negative association between nuts intake, diabetes, and cardiovascular disease. Since coronary heart disease, stroke and diabetes are the 1st, 3rd and 6th causes of death in the U.S. and since nuts protect against all of these conditions, efforts must be made to educate people that nuts should be considered a part of a healthy diet. WIC participants' beliefs and knowledge regarding the health effects of nuts is low, inadequate or incorrect with only about one forth indicating that nuts may help to reduce risk for diabetes and cardiovascular disease and more than one third believed that eating nuts will cause them to gain weight. Promotion of nuts consumption could be most successful if they are promoted by doctors and offered for an affordable price.

As a step toward increasing the variety and amount of nuts consumed by low income individuals who are increased risk for many chronic diseases and who may greatly benefit from increased nut consumption, federal feeding programs may need to consider increasing the amount and types of nuts provided. The Dietary Guidelines for Americans (DGA) recommendations are used on many levels to develop research, policy, and education curricula. Currently nuts are mentioned in the DGA only as an alternative source of protein. By including information about the health benefits of nut intake in the Dietary Guidelines, Americans may be more likely to learn that nuts should be considered a part of a healthy diet and federal feeding programs may be more likely to increase the availability of a variety of nuts in foods supplied. One example of the impact of DGA is the recent revision to the WIC food packages made by the Institute of Medicine (Institute of Medicine, 2005). The goal of that revision was to align WIC food packages with the 2005 version of the DGA. Since DGA only includes peanut butter, no other nuts were included in that report. Considering the latest findings regarding the effect of nuts intake on prevention of heart disease, diabetes and other conditions, not including nuts in WIC food packages is clearly a missed opportunity to further improve WIC participants overall diet, thus, reducing their risk for future chronic health conditions.

Acknowledgment

We are grateful to all participants for completing the survey questionnaire.

References

- Albert CM, Gaziano JM, Willett WC & Manson JE (2002). Nut consumption and decreased risk of sudden cardiac death in the physicians' health study. *Arch Intern Med* 162:1382-1387.
- Berkman L & Epstein AM (2008). Beyond health care-socioeconomic status and health. *NEJM* 358:2509-2510.
- Bes-Rastrollo M, Sabate J, Gomez-Gracia E, Alonso A, Martinez JA & Martinez-Gonzalez MA (2007). Nut consumption and weight gain in a Mediterranean cohort: the SUN study. *Obesity* 15:107-116.
- Coates A & Howe P (2007). Edible Nuts and Metabolic Health. *Curr Opin Lipidol* 18:25-30.
- Cortes B, Nunez I, Cofan M, Gilabert R, Perez-Heras A, Casals E, Deulofeu R & Ros E (2006). Acute effects of high-fat meals enriched with walnuts or olive oil on postprandial endothelial function. *J Am Coll Cardiol* 48:1666-1671.
- Curb JD, Wergowske G, Dobbs JC, Abbott RD & Huang B (2000). Serum lipid effects of a high monounsaturated fat diet based on macadamia nuts. *Arch Int Med* 160:1154-1158.
- Davis L, Stonehouse W, Loots DT, Mukuddem-Petersen J, van der Westhuizer FH, Hanekom SM & Jerling JC (2007). The effects of high walnut and cashew nut diets on the antioxidant status of subjects with metabolic subjects. *Eur J Nutr* 46:155-164.
- Garg ML, Blake RJ, Willis RB & Clayton EH (2007). Macadamia nut consumption modulates favorably risk factors for coronary artery disease in hypercholesterolemic subjects. *Lipids* 42:583-587.
- Gebauer SK, West SG, Kay CD, Alaupovic P, Bagshaw D & Kris-Etherton PM (2008). Effect of pistachios on cardiovascular disease risk factors and potential mechanisms of action: a dose-response study. *Am J Clin Nutr* 88:651-659.
- Institute of Medicine (2005). WIC food packages: time for change. <http://www.iom.edu/CMS/3788/18047/26667.aspx>. Accessed on 7/11/2005.
- Jenkins DJ, Kendall CW, Marchie A, Parker TL, Connelly PW, Qian W, Haight JS, Faulkner D, Vidgen E, Lapsley KG & Spiller GA (2002). Dose response of almonds on coronary heart disease risk factors: blood lipids, oxidized low-density lipoproteins, lipoprotein (a), homocysteine, and pulmonary nitric oxide. *Circulation* 106:1327-1332.
- Jiang R, Jacobs D & Mayer-Davis E (2006). Nut and Seed Consumption and Inflammatory Markers in the Multi Ethnic Study of Atherosclerosis. *Am J Epidemiol* 163:222-231.
- Jiang R, Manson JE, Stampfer MJ, Liu S, Willett WC & Hu FB (2002). Nut and peanut butter consumption and risk of type 2 diabetes in women. *JAMA* 288:2554-2560.
- Kris-Etherton PM, Hu FB, Ros E & Sabaté J (2008). The role of tree nuts and peanuts in the prevention of coronary heart disease: multiple potential mechanisms. *J Nutr* 138:1746S-1751.
- Mackenbach JP, Stirbu I, Roskam AJ, Schaap MM, Menvielle G, Leinsalu M & Kunst AE (2008). Socioeconomic inequalities in health in 22 European countries. *N Engl J Med* 358:2468-2481.
- Mukuddem-Peterson, J, Stonehouse W, Jerling JC, Hanekom SM & White Z (2007). Effects of a high walnut and high cashew nut diet on selected markers of the metabolic syndrome: a controlled feeding trial. *Br J Nutr* 97:1144-1153.
- Sabate J (2003). Nuts and body weight. *Am J Clin Nutr* 78:647S-650S.
- Salas-Salvado J, Fernandez-Ballart J, Ros E, Martínez-González MA, Fitó M, Estruch R, Corella D, Fiol M, Gómez-Gracia E, Arós F, Flores G, Lapetra J, Lamuela-Raventós R, Ruiz-Gutiérrez V, Bulló M, Basora J & Covas MI (2008). Effect of a Mediterranean Diet Supplemented With Nuts on Metabolic Syndrome Status: One-Year Results of the PREDIMED Randomized Trial. *Arch Intern Med* 168:2449-2458.
- Sabate J, Fraser GE, Burke K, Knutsen SF, Bennet H & Lindsted KD (1993). Effects of walnuts on serum lipid levels and blood pressure in normal men. *NEJM* 328:603-607.