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A Nutty Approach to Disease Prevention

Amin Esfahani
New York Medical College

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INTRODUCTION

The prevalence of type 2 diabetes has increased dramatically over the past three decades and current estimates predict a further 50% increase worldwide by the year 2030.[1] Diabetes is associated with numerous micro- and macrovascular complications including, blindness, kidney failure and limb amputation.[2] Furthermore, the presence of diabetes increases the risk of cardiovascular disease (CVD) two to five fold, especially for women.[3,4] Alongside the current global obesity epidemic[5,6], the increase in prevalence of diabetes is going to further strain the already-overburdened healthcare system of United States and potentially prove catastrophic for nations with limited resources.

While there is no available cure for diabetes, studies have shown that primary prevention can be attained through modifications to diet and lifestyle. Unfortunately, with mass media as a vehicle, the general public, for the most part, has been exposed to "fad diets" and "magic bullets" that not only lead to no metabolic benefits but may in fact, in some circumstances, prove harmful by depriving the body of many essential nutrients. These "quick-to-fix" approaches have drawn the attention away from the traditional staples of human diet such as whole grains, fruit, green leafy vegetable, seeds and nuts which have been linked by scientific evidence to a reduced risk of a number of chronic diseases including diabetes and CVD.[7] The purpose of this paper is to 1) provide a brief overview of the current evidence linking tree nuts to the risk of diabetes and heart disease and 2) to outline some of the key challenges for recommending nuts as part of a healthy diet to patients with or at risk of diabetes or heart disease.

TREE NUTS

The term, "nut", encompasses a wide range of seeds that based strictly on botanical definitions are not actually nuts. While hazelnuts meet the botanical definition, almonds, pistachios and walnuts which are all seeds of drupe fruits, do not. Despite this inconsistency, the aforementioned seeds, along with hazelnuts, pine nuts, pecans, cashews, Brazils, and macadamias have been clustered together under the collective term, "tree nuts" by the International Tree Nut Council.[8]

> ***"...tree nuts as a whole are healthy foods because of favorable fatty acid profile... as well as being good sources of protein, fiber, phytosterols, polyphenols, vitamins and minerals."***

Until recently, in Western societies, nuts were considered to be high fat and as such, contraindicated in therapeutic diets. However, scientific evidence in the past decade has changed this negative perception. Despite small variations in their micro- and macronutrient profiles, tree nuts as a whole are healthy foods because of their favorable fatty acid profile (low in saturated fats and high in mono- and polyunsaturated fats [MUFAs and PUFAs respectively]). They are also low in available carbohydrate content, as well as being good sources of vegetable protein, fiber, phytosterols, polyphenols, vitamins and minerals. Table 1 summarizes the micro- and macronutrient profile of some commonly consumed nuts. Nuts may therefore be a useful component of a dietary strategy aimed improving the risk factors of diabetes and CVD.

Table 1 Nutritional profile of commonly consumed, whole, natural nuts (per ounce)

	Almonds	**Cashews**	**Pecans**	**Pistachios**	**Walnuts**
Number of Kernels per Ounce	23	18	19 halves	49	14 halves
Total Energy, *kcal*	160	160	200	160	190
Protein, *g*	6	4	3	6	4
Carbohydrates, by difference, *g*	6	9	4	8	4
Fiber, total dietary, *g*	4	1	3	3	2
Total Lipids	14	13	20	13	18
Saturated fatty acids, *g*	1	3	2	1.5	1.5
Monounsaturated fatty acids, *g*	9	8	12	7	2.5
Polyunsaturated fatty acids, *g*	3.5	2	6	4	13
Cholesterol	0	0	0	0	0
Minerals, *mg* (% DV)*					
Calcium	75 (8)	13(0)	20(2)	31 (3)	28 (2)
Iron	1.1 (6)	1.7 (10)	0.7 (4)	1.2 (6)	0.8 (4)
Sodium	0 (0)	5 (0)	0 (0)	3 (0)	1 (0)
Potassium	200 (6)	160 (4)	116 (4)	295 (9)	125 (4)
Magnesium	76 (20)	74 (20)	34 (8)	34 (8)	45 (10)
Phosphorus	137 (15)	139 (15)	79 (8)	137 (15)	98 (10)
Zinc	0.9 (6)	1.6 (10)	1.3 (8)	0.6 (4)	0.9 (6)
Manganese	0.7 (30)	0.2 (10)	1.3 (60)	0.4 (20)	1.0 (50)
Copper	0.2 (15)	0.6 (30)	0.3 (15)	0.4 (20)	0.5 (25)
Selenium, *mcg*	0.7 (0)	3.3 (4)	1.1 (2)	2.6 (4)	1.4 (2)
Vitamins, *mg* (% DV)*					
Thiamin	0.06 (4)	0.06 (4)	0.19 (10)	0.24 (15)	0.1 (6)
Riboflavin	0.3 (15)	0.06 (4)	0.04 (2)	0.05 (2)	0.04 (2)
Niacin	1.0 (4)	0.4 (2)	0.3 (2)	0.4 (2)	0.3 (2)
Vitamin B-6, *µg*	0.04 (2)	0.07 (4)	0.06 (2)	0.36 (20)	0.15 (8)
Folate, total, *µg*	14 (4)	20 (4)	6 (2)	14 (4)	28 (6)
Vitamin E (total tocopherols)	(35)	(0)	(2)	(2)	(0)

Modified from tables prepared by the International Tree Nut Council[8], accessed on January 15, 2011. The values are for unsalted, unroasted nuts (except for cashews and pistachios which were dry roasted)*mg (miligram); %DV = % daily value

NUTS & HEART DISEASE

The protective effect of nuts in relation to the risk of CVD has been demonstrated in a number of cohort studies. A pooled-analysis of the results from four major cohorts[9-12] (sample size of over 170,000 individuals) demonstrated that in comparison to little or no nut consumption, the highest intake group for nut consumption (4 or more servings per week) had a statistically significant reduction of approximately 35% in the risk of developing coronary heart disease (CHD).[13]

Clinical interventions have supported the findings of the aforementioned cohort studies and have shed light on potential mechanisms of action. The dietary interventional studies have shown that nut consumption can reduce the risk of heart disease by improving serum lipid profile, endothelial function, and blood pressure, in addition to lowering oxidative stress, and inflammation.[14] Two systematic reviews showed that the intake of 1.5 to 3.5 ounces of nuts, 5 or more times per week, can reduce LDL-cholesterol (LDL-C) 3-19% in comparison to Western or lower fat diets.[15,16] Meta-analyses of clinical trials involving almonds or walnuts have demonstrated that both are effective in significantly lowering Total-C and LDL-C.[17,18] Furthermore, despite the absence of a pooled analysis, the results from 4 clinical trials show that the intake of 2 to 3.5 ounces (approximately 50 kernels/oz) of pistachios per day increased serum HDL-C levels.[19-22] The strength of the evidence has prompted the United States Food and Drug Agency (USFDA) to approve a qualified health claim for nuts and serum cholesterol reduction.

NUTS AND TYPE 2 DIABETES

While the current evidence demonstrates that the frequent intake of nuts is protective against heart disease, the effect of nuts on the risk of developing type 2 diabetes is not as conclusive. Of the two cohort studies on this topic, one showed a 27% reduction in the relative risk of developing diabetes in individuals who consumed nuts five or more times per week compared with those who rarely or never ate nuts[23], while the other did not show a link between nut/peanut intake and the risk of type 2 diabetes.[24]

Despite the inconsistency in the epidemiological evidence, there are a number of plausible mechanisms that suggest a potential protective effect for nuts against the risk of type 2 diabetes. The first relates to the low available carbohydrate content of nuts (Table 1). Adequate glycemic control is crucial for prevention and management of type 2 diabetes.[25] A number of acute studies have shown that almonds are capable of improving post-meal glyciemic control through low post-meal glucose and insulin responses.[26, 27] Both of these parameters have been linked to improved insulin sensitivity, prevention of hyperinsulinemia and overall, improved glycemic control in patients with type 2 diabetes.[28] However, despite plausible evidence it is not clear if improvements in acute glycemia are indicative of long term changes in insulin resistance. Moreover, the limited number of long-term clinical trials in this area have been inconclusive, with some showing benefits in fasting insulin and glucose and others showing no effect.[29] Worth noting is that no study to date has shown improvements in HbA1c (established marker of long-term glycemic control). However, these long-term term trials have had a number of limitations, which have been outlined in other publications.[14]

Several other lesser studied mechanisms for reducing the risk of diabetes include: reduction in inflammation[30], which has been linked to the risk of diabetes and heart disease[31], or improvement in glycemic control through displacement of carbohydrates with MUFAs (high in nuts)[32]. Finally, a recent meta-analysis of the prospective studies showed that a 100mg per day increase in dietary magnesium intake reduced the risk of developing diabetes by 14%.[33] Nuts are good sources of magnesium (Table 1).

The current body of scientific research demonstrates that nuts may have a modest beneficial effect on serum lipids and markers of glycemia in subjects with type 2 diabetes.[14, 34] Therefore, the moderate use of nuts as a part of a healthy diet and in very high risk populations alongside medication may help better manage diabetes. Furthermore, while the assessment of long-term effect of nuts in prevention and management of diabetes is required, due to the potentially favourable effects on glycemia and inflammation intake of nuts may benefit those at risk of developing diabetes.

KEY CHALLENGES

There are a number of concerns associated with recommending the intake of nuts to high risk populations (e.g. patients with diabetes). Food allergy is one of these concerns. Currently, 0.4% of the US population are allergic to tree nuts (most prevalent allergies are those to walnuts, cashews and almonds).[35] This type of allergy is a major contributor to the overall 100-200 annual deaths that result from food-induced anaphylaxis.[36]

There are also several important research areas that need to be addressed when assessing the impact of nuts on health outcomes. One is the aforementioned, long term effect on markers of diabetes. Another has to do with the fact that despite similarities, there are still differences in micro- and macronutrient profiles of specific nuts, which may lead to different metabolic effects. Therefore, more trials need to be conducted using the "lesser-studied" tree nuts in order to determine whether they generate comparable metabolic benefits to almonds, walnuts and pistachios (the "more studied" tree nuts). Furthermore, the efficacy of mixed-nut diets should also be examined. Finally, dose-response studies should be conducted, in order to determine the ideal intake levels for maximal metabolic benefits and to also establish detrimental doses.

The most common cited concerns with nut consumption are their high fat content and energy density, which some fear will lead to weight gain and consequently, obesity. However, the overall evidence from epidemiological studies not only shows no association between nut intake and weight gain, but it in fact points to an inverse trend.[37] Furthermore, evidence suggests that in the context of energy-restricted diets, the addition of nuts generates a more lasting and greater magnitude of weight loss among obese subjects.[38] One mechanism of action that has been studied in almonds, suggests that the cell walls of almonds decrease the bioaccessibility of lipids by hindering their availability for digestion.[39] However, more clinical trials are required to assess the impact of nuts on weight loss and if applicable, to help determine the potential mechanisms of action. Overall, addressing these key challenges will allow governing agencies to make better recommendations to the general public.

CONCLUSION

Tree nuts on their own are not "magic bullets" that will prevent chronic diseases. However, the current body of scientific evidence shows that their addition to healthy diets leads to additional metabolic benefits. For instance, the addition of nuts to a vegan-diet rich in plant sterols, vegetable proteins and soluble fiber led to reductions in LDL-C similar to those obtained with starting doses of Statin medication.[40] Furthermore, their inclusion in the Mediterranean or weight loss diets has improved the efficacy of these diets in comparison to the currently recommended therapeutic diets.[41-43] Overall, the intake of nuts as part of a healthy diet can improve risk factors of heart disease, short-term glycemic control and to a limited extent enhance weight loss. As such, in lieu of their energy density, healthy individuals and those at high risk of type 2 diabetes and/or heart disease will benefit from the inclusion of nuts in their diets.

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