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# Walnuts and dietary approaches to the prevention and management of abnormal lipid profiles in Type 2 diabetes mellitus

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# Walnuts and dietary approaches to the prevention and management of abnormal lipid profiles in Type 2 diabetes mellitus

## **Abstract**

Dietary fat is considered central to the management of obesity and heart disease risk, and more recently with the risk of type 2 diabetes, given its observed role in the development of insulin resistance in mechanistic studies. For changes in lipid profiles, foods delivering substantial amounts of polyunsaturated fatty acids relative to saturated fats are of interest, and walnuts fit this category. As a class of foods, nuts have been shown to provide benefits to health in a number of clinical trials. A review of the cardiovascular benefits of nuts indicated their value on thrombotic factors, inflammatory markers and endothelial function. Including 30g walnuts per day in a dietary advice scheme that related to all major food groups resulted in beneficial lipid profiles for adults with early type 2 diabetes mellitus. Walnuts should be 'prescribed' to adults with type 2 diabetes mellitus. In clinical practice prescribing walnuts assists the clinician in giving more detailed dietary advice that is likely to be on target for the desired outcomes. The reality for 'free living' conditions is that foods such as walnuts may need to be considered core foods in these treatment strategies, as they help to 'take the guesswork' out of ensuring adequate intakes of polyunsaturated fats.

## **Keywords**

walnuts, type 2 diabetes mellitus, lipids

## **Disciplines**

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1 **The position of walnuts in dietary approaches to the prevention and management of type 2**  
2 **diabetes mellitus**

3 Walnuts and Diabetes

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- 1 **The position of walnuts in dietary approaches to the prevention and management of type 2**
- 2 **diabetes mellitus**
- 3 Walnuts and Diabetes

## 1 Executive Summary

### 2 Dietary fat and diabetes

- 3 • Dietary fat is considered central to the management of obesity and heart disease risk, and more  
4 recently with the risk of type 2 diabetes, given its observed role in the development of insulin  
5 resistance in mechanistic studies.
- 6 • For changes in lipid profiles, foods delivering substantial amounts of polyunsaturated fatty acids  
7 relative to saturated fats are of interest, and walnuts fit this category.

### 8 Nutritional composition of walnuts

Per 100g	Energy (kJ)	Fat (g)	Fat Saturated (g)	Fat Monounsaturated (g)	Fat Polyunsaturated (g)	Fat Omega-3 (mg)
Walnut	2901	69.2	4.4	12.1	49.4	6260
Pistachio	2530	50.6	5.8	26.6	15.8	0
Pine Nut	2921	70.0	4.2	23.0	39.8	0
Pecan	2977	71.9	4.5	39.1	24.8	620
Macadamia	3068	76.2	10.3	61.4	0.9	0
Hazelnut	2693	61.4	2.7	48.6	7.1	120
Cashew	2437	49.2	8.4	31.1	7.5	0
Brazil	2888	68.5	14.8	21.8	29.0	0
Almond	2525	55.2	3.6	36	13.1	0

### 9 Benefits of walnuts

- 10 • As a class of foods, nuts have been shown to provide benefits to health in a number of clinical trials.
- 11 • A review of the cardiovascular benefits of nuts indicated their value on thrombotic factors,  
12 inflammatory markers and endothelial function.

### 13 Walnuts in the context of the whole diet

- 14 • Including 30g walnuts per day in a dietary advice scheme that related to all major food groups  
15 resulted in beneficial lipid profiles for adults with early type 2 diabetes mellitus.

### 16 Walnuts should be 'prescribed' to adults with type 2 diabetes mellitus

- 17 • In clinical practice prescribing walnuts assists the clinician in giving more detailed dietary advice  
18 that is likely to be on target for the desired outcomes.

- 1 • The reality for 'free living' conditions is that foods such as walnuts may need to be considered core
- 2 foods in these treatment strategies, as they help to 'take the guesswork' out of ensuring adequate
- 3 intakes of polyunsaturated fats.

4

## 1 **Introduction**

2 Walnuts are a high fat food, but they deliver desirable fats in a food matrix favourable to the prevention  
3 and management of type 2 diabetes mellitus. In the first instance, significance of walnut fatty acids is  
4 perhaps best viewed in the context of heart disease risk associated with diabetes.

5 The link between diet and the risk of coronary heart disease has been known for decades, beginning  
6 with the early observation by Keys and colleagues of higher rates of heart disease in populations with  
7 higher consumption of saturated fatty acids [1]. Since that time the knowledge base has expanded  
8 substantially through research from a number of disciplines. Cellular and animal model studies have  
9 provided explanations of possible mechanisms, epidemiological research has established relationships  
10 between dietary variables and risk factors, and clinical trials have demonstrated the effects of dietary  
11 intervention. Further, observations of pathological and treatment commonalities between type 2  
12 diabetes, obesity and coronary heart disease have been described through the concept of metabolic  
13 syndrome [2].

14 Dietary fat is considered central to the management of obesity and heart disease risk, and more recently  
15 with the risk of type 2 diabetes, given its observed role in the development of insulin resistance in  
16 mechanistic studies [3]. A recent review of human research has argued how the type of fat may be  
17 linked to the development of diabetes, with studies showing that replacing saturated and trans fats with  
18 unsaturated fats, and including nuts in the diet may help to prevent diabetes [4].

19 In the case of obesity, a low fat approach to diet has been promulgated, given the energy density of high  
20 fat foods [5], and in cardiovascular disease the type of fat is addressed, given the differential effects of  
21 fatty acids on blood lipids [6]. While much of the focus of dietary treatment in diabetes has been on  
22 blood glucose control, and thereby dietary carbohydrate, a number of studies in patients with metabolic  
23 syndrome have proven the effects of manipulating the type of fat in improving insulin sensitivity [7]. A  
24 further reason for addressing dietary fat in the diabetic population has been the recognised need to treat  
25 dyslipidemia, given the higher risk of cardiovascular disease in this disease group [6, 8].

26 Translating theory to practice, however, remains a challenge, especially as advice should relate to foods  
27 not nutrients. The nutrient composition of foods provides some guidance, but further evidence is  
28 required on the impact of targeted foods on changing biomarkers of risk. For changes in lipid profiles,  
29 foods delivering substantial amounts of polyunsaturated fatty acids relative to saturated fats are of  
30 interest, and walnuts fit this category. This review examines the position of walnuts in the diet for the  
31 prevention and management of type 2 diabetes mellitus. First, the nutritional profile of walnuts is  
32 argued as favourable for the disease state and evidence of their benefits is cited from the literature.

1 Finally, it is emphasised that the means by which walnuts deliver benefits is dependent on their position  
2 in the whole diet, bearing in mind the patient's overall nutritional requirements and need for energy  
3 balance.

#### 4 **Nutritional composition of walnuts**

5 Like all natural foods, walnuts have a distinct composition. Most notably, they contain substantial  
6 amounts of both n-6 and n-3 fatty acids, the latter in the form of  $\alpha$ -linolenic acid. This differentiates  
7 walnuts from other nuts, bearing in mind that as a group, nuts deliver unsaturated fatty acids (Table 1).  
8 Both n-6 and n-3 fatty acids are limited in the diet, but n-3 even more so, and there is argument that the  
9 balance between n-3 and n-6 fatty acids is an important consideration in disease risk management [9].

10 **Table 1 Nutritional analysis of tree nuts<sup>a</sup>**

Per 100g	Energy (kJ)	Fat (g)	Fat Saturated (g)	Fat Monounsaturated (g)	Fat Polyunsaturated (g)	Fat Omega-3 (mg) <sup>b</sup>
Walnut	2901	69.2	4.4	12.1	49.4	6260
Pistachio	2530	50.6	5.8	26.6	15.8	0
Pine Nut	2921	70.0	4.2	23.0	39.8	0
Pecan	2977	71.9	4.5	39.1	24.8	620
Macadamia	3068	76.2	10.3	61.4	0.9	0
Hazelnut	2693	61.4	2.7	48.6	7.1	120
Cashew	2437	49.2	8.4	31.1	7.5	0
Brazil	2888	68.5	14.8	21.8	29.0	0
Almond	2525	55.2	3.6	36	13.1	0

11 <sup>a</sup> Foodworks nutrient analysis software package, AusNut Database, Xyris software, Highgate Hill, Brisbane Australia 3.2, 2002.

12 <sup>b</sup> Foodworks nutrient analysis software package, Fatty Acid Database, Xyris software, Highgate Hill, Brisbane Australia 3.2, 2002.

13 In addition to fatty acids, the walnut food matrix also includes protein (rich in arginine), fibre, and anti-  
14 oxidants, largely in the form of  $\gamma$  tocopherol and various polyphenolic compounds. Recent research has  
15 found a link between arginine intake and lower levels of a biomarker of heart disease, C-reactive  
16 protein [10]. Another study has found potential benefits of arginine in weight loss [11]. The arginine-  
17 rich protein and natural fibre components of walnuts may have benefits in themselves, bearing in mind  
18 that both protein and fibre play a role in appetite control.

19 Given the unsaturated fat content of walnuts, however, the presence of anti-oxidants is an important  
20 consideration. While foods containing polyunsaturated fats may be seen as desirable, supplemental  
21 studies indicate that the oxidative stability of plasma and LDL may be at risk with the delivery of high



1 levels of unsaturated fatty acids [12]. There is evidence that oxidative stress plays a role in  
2 atherogenesis, and that  $\gamma$  tocopherol may have protective functions [13]. Polyphenolics in walnuts have  
3 been found to act as effective inhibitors of in vitro plasma and LDL oxidation [14]. More recent animal  
4 model research has extended this view, showing oxidative stress to be reduced in mice supplemented  
5 for 4 weeks with a polyphenol-rich walnut extract [15]. While research on bioactive ingredients in food  
6 is necessarily reductionist, there is something to be said for the benefits of the whole food matrix via  
7 the synergies that are created from the combination of nutrients. This may partly explain the apparent  
8 anomalies in recent vitamin supplementation trials where nil benefits were found on CVD risk [16, 17],  
9 despite positive correlations between health outcomes and the intake of foods such as vegetables and  
10 fruits delivering these vitamins [18].

11 For all of these reasons, the nutritional profile of walnuts clearly suits the dietary needs of patients with  
12 type 2 diabetes mellitus.

### 13 **Benefits of walnuts**

14 As a class of foods, nuts have been shown to provide benefits to health in a number of clinical trials.  
15 Given the higher unsaturated fat content of nuts, this outcome would be expected under conditions  
16 where the P:S ratio of the whole diet was favourable. It is also shown in studies where patients  
17 consumed nuts on a daily basis. Outcomes in hypercholesterolemic patients included reduced total  
18 and/or LDL-cholesterol concentrations [19-21], and changes to lipid distribution among lipoprotein  
19 sub-classes with walnuts [22]. Not surprisingly, given the links between dietary fats and insulin  
20 resistance, analyses from cohort studies have suggested reduced risk of type 2 diabetes mellitus in  
21 women with higher nut consumption [23].

22 Given the high energy density of nuts, however, energy balance may be an issue in those wishing to  
23 lose weight. One review found inclusion of nuts in the diet did not result in body weight change in 12  
24 of the 13 trials reporting body weight change [24]. A more recent review argued that the continued  
25 observation of no weight gain with inclusion of nuts (even in the context of apparent increased energy  
26 intake) may be due to inefficient absorption, increased energy expenditure, and increased satiety [25].  
27 This again, points to the whole food matrix as being a significant dietary consideration. In a recent  
28 study of patients with type 2 diabetes mellitus, percent body fat remained below the baseline  
29 measurement with the diet inclusive of walnuts compared to standard clinical practice [26], a finding  
30 that warrants further investigation with greater numbers of subjects.

31 A review of the cardiovascular benefits of nuts indicated their value on thrombotic factors,  
32 inflammatory markers and endothelial function [27]. Walnuts were singled out as associated with

1 reduced total cholesterol, LDL, triacylglycerol, and LDL:HDL ratios, as well as improved brachial artery  
2 reactivity and reduced levels of vascular cell adhesion molecule-1.

3 While the favourable fatty acid profile of nuts would explain cardiovascular benefits, the differences  
4 seen between studies involving nuts may be due to differences in overall composition. It may also  
5 reflect the extent of detail in the attention paid to overall diet in the research design. An extensive  
6 review of the scientific evidence for the beneficial health relationship between walnuts and coronary  
7 heart disease conducted in 2002 found lowered blood cholesterol concentrations in heart health  
8 promoting diets containing walnuts [28]. The limitations of the research to date related to the length of  
9 time of the studies and the need for research more reflective of 'real life' contexts. The latter is a  
10 problem for randomised controlled trial (RCT) methodology, but in dietary trials especially, the closer  
11 the study can match free living conditions the closer the evidence will lie to efficacy in clinical practice.

## 12 **Walnuts in the context of the whole diet**

13 Current practice guidelines recommend the inclusion of food sources of nutrients targeted as beneficial  
14 in the treatment of diabetes and heart disease in particular. [20, 29-32]. To meet dietary targets for  
15 nutritional adequacy a variety of core foods is required; to meet targets of macronutrient proportions,  
16 specific foods need to be emphasised because of their unique value and attributes. For example,  
17 American Heart Association recommends including unsaturated fatty acids from fish, vegetables,  
18 legumes and nuts in order to achieve a healthy diet [6].

19 Including 30g walnuts per day in a dietary advice scheme that related to all major food groups resulted  
20 in beneficial lipid profiles for adults with early type 2 diabetes mellitus [26]. This study demonstrated  
21 the way in which walnuts needed to be located in the overall diet by exposing a dietary modelling  
22 process whereby other foods in the diet were encouraged or delimited [33]. The beneficial effects were  
23 no doubt due largely to the dietary fatty acid profile of the overall diet, but clearly the inclusion of the  
24 walnuts enabled that to happen much more effectively than standard clinical practice or even a more  
25 detailed advice scheme that nevertheless did not name specific foods. This is the way in which whole  
26 foods can exert their effects. The clinical outcome is not a single food effect, but the positioning of  
27 single foods delivering significant and important nutrients makes all the difference. In another study of  
28 hypercholesterolemic men and women emphasising walnuts in a Mediterranean diet (over other  
29 monounsaturated fat rich foods) resulted in greater improvement in endothelium dependent  
30 vasodilation and greater reductions in levels of vascular cell adhesion molecule – 1 compared to the  
31 standard Mediterranean diet. Reductions in cholesterol were correlated with increased dietary ALA and  
32 LDL  $\gamma$  tocopherol levels, both reflecting walnut composition [34]. Again this demonstrates the impact  
33 of positioning walnuts in the context of the whole diet.

1 In clinical practice prescribing walnuts assists the clinician in giving more detailed dietary advice that  
2 is likely to be on target for the desired outcomes. The reality for 'free living' conditions is that foods  
3 such as walnuts may need to be considered core foods in these treatment strategies, as they help to 'take  
4 the guesswork' out of ensuring adequate intakes of polyunsaturated fats, in addition to the other  
5 benefits they bring as whole foods. Other foods such as fish and dairy foods may have the same role to  
6 play, and their attributes may be demonstrated in a similar fashion. As knowledge of the composition  
7 of whole foods and their unique attributes increases there are implications for the improved formulation  
8 of manufactured foods, in particular snacks. While it is unlikely that whole foods will play a role in  
9 therapeutics, their real significance in the prevention and management of risk factors for lifestyle  
10 disease is clearly unfolding.

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