



NUTS AND HEART HEALTH

A summary of the evidence



Incorporating the key findings of a new systematic literature review



FOREWORD

By Professor Linda Tapsell AM PhD FDA

Heart health is a general term relating to the support and maintenance of the cardiovascular system. We can examine the evidence for heart health by considering the relative risk of heart disease and the presence of risk factors such as high blood cholesterol levels. Overweight is itself a risk factor, but it can also influence other risk factors such as blood cholesterol levels. Diet is known to influence all these factors, so it is useful to know what parts of the diet make a difference.

Choosing a healthy diet requires an ability to discriminate between a wide range of foods and to appreciate the value of foods that really count in promoting health. While the development of cardiovascular disease and being overweight reflects the total diet, the foods that make up this diet are important.

This report focuses on the particular value of tree nuts. The significant contribution of nuts to a healthy diet can be easily underestimated. For example, they are often relegated to the 'snack food' category. Some people may avoid nuts when trying to lose weight or to limit fat intake for heart health. Today, the scientific evidence provides a very different perspective that deserves attention.

This summary outlines an extensive systematic review of the scientific literature conducted with Landmark Nutrition. Systematic reviews are based on an important methodology that describes how studies are identified and reviewed in a transparent fashion so that it is clear how conclusions are arrived at. Little is ever really definite in science, but we can make reasonable judgements based on a systematic review of the body of evidence.

The report highlights the importance of nuts as a food of real value, delivering the right kind of fats, and with little association with weight gain. In particular the report focuses on the impact of regular nut consumption on reducing the risk of cardiovascular disease.

The review establishes that regular nut consumption is associated with a reduced risk of death from heart disease and a reduction in risk factors for heart disease. Including nuts as a regular part of a healthy diet may help to reduce LDL cholesterol and total cholesterol and establish a healthier LDL:HDL ratio, a key indicator of heart disease risk.

The research shows the benefits of regular nut consumption are sustainable. Prospective cohort studies of regular nut consumers show consistent associations with healthier outcomes for periods as long as 20 years.

Importantly the relationships with heart health are observed without adverse effects on weight. An additional review of studies on nuts and weight showed the relationship with eating nuts was more aligned with a healthier weight and waist circumference. This research indicates that regular consumption of nuts is not likely to be accompanied by overconsumption of energy in the total diet, leading to overweight.

The amount of nuts consumed on a daily basis in these studies was generally around 30 grams. Current Australian surveys indicate nut consumption levels are much lower than this, suggesting room for improvement. The protective effects described through regular nut consumption are aligned with other plant foods such as vegetables, fruits and grains. This translates to a daily inclusion of nuts in the diet being 'front of mind' as it needs to be for these other plant foods.

Overall, the report summarised here provides solid and consistent evidence for the heart health benefits of regular nut consumption. This is a significant contribution to the evidence supporting the full array of food choice, activity and lifestyle behaviors that go together to support the cardiovascular system throughout life.

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Professor Tapsell is Director of the Smart Foods Centre at the University of Wollongong and serves on a number of food and nutrition related advisory boards and expert committees. She has lead a number of trials examining the effects of different nutrient dense foods on health outcomes and has received research related funds through various sources including NHMRC, ARC, California Walnut Commission, Nuts for Life, and Horticulture Australia Limited.



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INTRODUCTION

This report is a summary of the latest evidence on nuts and the important role they play in cardiovascular health. It incorporates a summary of a new systematic literature review of just over 100 studies conducted by academics from Landmark Nutrition and the University of Wollongong's Smart Food Centre, the findings support a general level health claim that daily nut consumption, as part of a healthy, varied diet, contributes to heart health.

This research adds to the extensive body of evidence for nuts and health. In addition to the important role in cardiovascular health, nuts have previously been shown to help manage weight, lower the risk of type 2 diabetes and increase longevity.¹⁻¹⁴

Nuts are nutrient dense foods. A healthy handful, 30 grams, of mixed nuts provides healthy monounsaturated and polyunsaturated fats, protein, fibre, vitamin E and a range of natural plant phytochemicals and compounds with antioxidant potential, including flavonoids and resveratrol. They also include important minerals such as copper, magnesium, manganese, selenium and zinc – see table 5.

Nuts for Life is delighted to bring this report and the key findings of the systematic literature review to light. The evidence is solid and consistent.

Nuts are a unique whole food with a wide range of cardio-protective nutrients and strong evidence supports their position as a vital part of any diet aimed at promoting heart health. We encourage everyone to enjoy a healthy 30 gram handful of nuts every day.

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Nuts for Life is a health and nutrition education program voluntarily funded by 30 of the Australian Tree Nut Industry's growers, importers, processors, packers and small retailers. The program also receives Australian Government matched funding through Horticulture Innovation Australia for R&D activities, including the commissioning of this systematic literature review.

NUT CONSUMPTION IN AUSTRALIA

The Australian Dietary Guidelines define a serving of nuts as 30 grams and encourage regular consumption as part of the protein food group, which includes lean meats, poultry, fish, eggs, tofu, seeds, and legumes/beans.¹⁵

The guidelines also provide allowances for the consumption of foods providing unsaturated fatty acids, including an additional 10 grams of nuts, in the fats and oils group. The advice includes limiting saturated fat intake by replacing unhealthy saturated fats with healthy mono - and polyunsaturated fats like those found in nuts and avocados.¹⁵

According to the Australian Health Survey 2011-13, just 15.6% of people ate nuts on the day of the survey, with an average nut consumption of 5.2 grams.¹⁶ While this is a 60% increase in the amount of nuts being consumed since the 1995 National Nutrition Survey¹⁷, nut consumption in Australia still falls a long way short of the recommended 30 grams handful. The dietary modelling report that underpins the guidelines noted that Australian adults need to increase nut consumption by 350% to reach modelling targets.¹⁸

HEART DISEASE IN AUSTRALIA

Cardiovascular disease (CVD) refers to all diseases and conditions involving the heart and blood vessels, including coronary heart disease, stroke and heart attack. CVD is one of Australia's largest health problems. Despite improvements in the past few decades, it remains one of the biggest health burdens, affecting one in six or 3.72 million Australians.¹⁹

CVD is a major cause of death in Australia, killing one Australian every 12 minutes and accounting for 43,946 or 30% of all deaths in 2012. These are deaths that are largely preventable.¹⁹

Risk factors include high blood pressure, high cholesterol, overweight and obesity, and poor diet. According to the National Heart Foundation 90% of Australians have at least one risk factor for CVD and one in four (25%) have three or more risk factors. High cholesterol affects a third of adult Australians or 5.59 million and nearly two thirds (63%) are overweight or obese.¹⁹

“ The dietary modelling report that underpins the dietary guidelines noted Australian adults need to increase nut consumption by 350% to reach modeling targets. ”



NUTS AND HEART HEALTH

A REVIEW OF THE EVIDENCE: FROM A SYSTEMATIC LITERATURE REVIEW

METHODOLOGY

In late 2014, Nuts for Life commissioned Landmark Nutrition to conduct a full systematic literature review (SLR) to determine whether a greater consumption of nuts would improve measures of heart health while having no adverse outcomes on weight.

The research question for the review was:

Does a greater consumption of nuts, or of specific types of nuts, result in improved heart health (as demonstrated by favourable effects on cardiovascular disease risk factors, and a decreased risk of cardiovascular disease with no apparent adverse effect on body weight) in humans?

The full SLR examines the results of just over 100 scientific papers and was conducted by Dr Elizabeth Neale, PhD, BND (Hons.), Landmark Nutrition and University of Wollongong; Dr Deborah Nolan-Clark, PhD, BND (Hons.), Landmark Nutrition, in conjunction with Professor Linda Tapsell AM PhD FDAA, University of Wollongong.

The SLR was conducted in accordance with the methodology required by Food Standards Australia and New Zealand (FSANZ) in Schedule 6 of Standard 1.2.7 – Nutrient, health and related claims - for the self-substantiation of general level health claims. As a result, only intervention studies with control groups and longitudinal studies were included. Cross-sectional studies were excluded. Overall the evidence was restricted to analyses that reported on health outcomes preceded by nut intake. Each study was assessed for the quality of the study methodology using Health Canada Quality Appraisal Tools. The consistency of the association – ranked as low, moderate and high for the studies combined (the body of evidence), was also assessed using the Health Canada Guidance document.²⁰

The review characterised the heart health impacts of nuts in terms of cardiovascular and coronary heart disease end points, which were selected because of their consistently favourable associations with improved cardiovascular health. These included changes in total cholesterol, low density lipoprotein (LDL) cholesterol and the ratio of LDL cholesterol to high density lipoprotein (HDL) cholesterol – LDL:HDL ratio.

In addition the effect of nuts on weight variables were also assessed to determine if regular nut consumption would lead to weight gain – refer to page 10 for further information.

INTERVENTION STUDIES FOR CARDIOVASCULAR OUTCOMES

Eighty two intervention studies were included in the review and consuming tree nuts was consistently associated with a reduction in three important measures related to heart health - total cholesterol, LDL cholesterol and LDL:HDL ratio.

- **Total cholesterol and LDL cholesterol:** The consumption of all tree nut varieties was associated with a moderately consistent reduction of 3.5% for total cholesterol and 4.2% for LDL cholesterol (average¹ change from the tree nut data).²⁰
- **LDL:HDL Ratio:** LDL:HDL ratio is an important indicator of heart disease risk – the smaller the ratio the less likely heart disease will occur. Intake of tree nuts was associated with a highly consistent reduction in LDL:HDL ratio with the average change from the data showing a reduction of 7.3%.²⁰
- **Triglycerides:** The average change from the tree nut data showed a reduction in triglycerides of 5.4%.²⁰ However, the effects were less consistent than that seen for LDL and total cholesterol.
- **HDL cholesterol and blood pressure:** A lack of a consistent positive effect was observed for intake of tree nuts and measures of systolic and diastolic blood pressure and HDL cholesterol.²⁰

Eating tree nuts was consistently associated with a reduction in total cholesterol of around 3.5%, LDL cholesterol of 4.2% and improved the LDL:HDL ratio by 7.3%



Of the intervention studies, there were several studies demonstrating favourable effects that were of high quality some examples are below.

- In a crossover design intervention trial of eighteen people with high cholesterol, each participant was randomly assigned to a healthy diet where 40% of the fat was replaced by either extra virgin olive oil, walnuts or almonds. The amount of nuts each day varied from 40-65 grams (walnuts) and 50-75 grams (almonds), according to participants' total energy intake. After four weeks, each of the interventions resulted in a significant reduction in LDL cholesterol - by 7.3% for the olive oil group, 10.8% for the walnut group and 13.4% for the almond group (P=0.001). In addition, total cholesterol and LDL:HDL ratio decreased (P values 0.012 and 0.005 respectively) and there was a slight weight loss.²¹
- In another trial, the impact of a nut consumption on blood lipids was investigated by comparing diets containing 42 grams macadamias a day to the average American diet in 25 people with mildly elevated cholesterol over 5 weeks. The macadamia diet resulted in significant reductions in total, LDL and HDL cholesterol as well as improvements in the LDL:HDL ratio, (all P < 0.05) thereby lowering cardiovascular disease risk.²²
- The benefits of nut consumption on lipid profiles was also tested in an intervention trial of 23 people with either normal or moderately elevated blood cholesterol in a crossover trial over four weeks. A diet containing 70 grams pecans a day, which replaced 20% of the energy, was compared to a control. The pecan diet reduced total cholesterol by 6.7%, LDL cholesterol by 10.4%, respectively (all P < 0.05) while increasing HDL cholesterol (P < 0.001) and not increasing body weight.²³

- One of the best known studies is the PREDIMED trial, a multicentre randomised controlled trial that assessed the effect of a Mediterranean diet supplemented by either olive oil or 30 grams mixed nuts a day in a large sample of older adults at risk of cardiovascular disease over a five year period. Nuts and olive oil were found to be key components of the Mediterranean diet driving effective reduction of cardiovascular disease risk.^{2, 24}



Table 1: Consistency of favourable effects found for consumption of nuts on cardiovascular variables in intervention studies

OUTCOME OF INTEREST	CONSISTENCY RATING ON DIRECTION OF FAVOURABLE EFFECT
Total cholesterol	Moderate
LDL cholesterol	Moderate
HDL cholesterol	Low
LDL:HDL cholesterol ratio	High
Triglycerides	Moderate
Systolic blood pressure	Low
Diastolic blood pressure	Low

¹Average is a simple unweighted mean



OBSERVATIONAL STUDIES FOR CARDIOVASCULAR OUTCOMES

The evidence from 15 observational studies suggests that increased nut consumption is associated with a moderately reduced risk of death from both coronary heart disease and cardiovascular disease. A sample of these studies are highlighted in table 3.

The observational research examined for the review included studies with very large sample sizes followed over a long period of time, for example:

- A study of 118,962 (76,464 women and 42,498 men) followed over 30 years found that those who ate around 30 grams or a handful of nuts seven or more times a week were 20% less likely to die from all causes than those who ate nuts less than once a week (P<0.001 for trend) and 30% less likely to die from heart disease (P<0.001 for trend).¹
- Another study of 86,016 women over 14 years found that those who ate around a 30 gram handful of nuts more than five times a week had a 35% reduced risk of total coronary heart disease than women who never ate nuts (P for trend=0.0009).⁷

One major study found that eating a handful of nuts a day was associated with a 20% reduction in death from all causes and a 30% reduction in death from heart disease. *Bao et al NEJM 2013*¹

Table 2: Consistency of favourable effects for consumption of nuts on cardiovascular outcomes in observational studies

OUTCOME OF INTEREST	CONSISTENCY RATING ON DIRECTION OF FAVOURABLE EFFECT
Cardiovascular disease mortality	Moderate
Hypertension	Low
Coronary heart disease mortality	High
Stroke	Low
Non-fatal myocardial infarction	Low

“ Nut consumption is associated with a moderately reduced risk of death from coronary heart disease and cardiovascular disease. ”

Table 3: Effect of nut consumption on risk of heart disease – examples of epidemiological evidence

STUDY	NUMBER OF SUBJECTS (SEX)	ENDPOINTS	NUT CONSUMPTION FREQUENCY	RELATIVE RISK*	P FOR TREND
Nurses Health Study ⁷	86,016 (F)	Total CHD	Almost never ≥5 serves/week	1.00 0.65 (0.47-0.89)	0.0009
		Non-fatal MI	Almost never ≥5 serves/week	1.00 0.68 (0.47-1.00)	0.04
Nurses Health Study & Health Professionals Follow up study ¹ 30 year follow up	118,962 (F&M)	Fatal CHD	<1 serve/week ≥5 serves/week	0.84 (0.77-0.91) 0.71 (0.63-0.81)	0.001
		Fatal CVD	<1 serve/week ≥5 serves/week	0.84 (0.78-0.90) 0.75 (0.62-0.84)	0.001
Californian Seventh Day Adventist Health Study ⁸	26,473 (F&M)	Non-fatal MI	<1 serve/week ≥5 serves/week	1.00 0.49 (0.28-0.85)	<0.005
		Fatal CHD	<1 serve/week ≥5 serves/week	1.00 0.52 (0.36-0.76)	<0.001
Physicians Health Study ⁵	21,454 (M)	Sudden CHD death	<1/month ≥ 2 serves/week	1.00 0.53 (0.30-0.92)	0.01
		Total CHD death	<1/month ≥2 serves/week	1.00 0.70 (0.50-0.98)	0.06
Iowa Women's Health Study ⁶ 15 year follow up	31,778 (F)	Fatal CHD	<1 serve/week ≥5 serves/week	1.03 (0.84-1.26) 0.71 (0.55-0.91)	0.02
		Fatal CVD	<1 serve/week ≥5 serves/week	1.00 (0.86-1.17) 0.72 (0.60-0.88)	0.0008
PREDIMED Mediterranean diet 4.8 year follow up ²	7,261 (F&M)	Fatal CVD	<1 serve/week >3 serves/week	1.00 0.42 (0.20-0.89)	0.031

* multivariate-adjusted

NUTS AND BODY WEIGHT

Sixty eight interventions were reviewed and researchers found eating nuts was not associated with weight gain. In fact, the studies showed average slight reductions in weight by 0.32%, BMI by 0.67% and waist circumference by 0.84% based on a consumption of nuts ranging from 15-126 grams a day. The changes in weight-related variables were highly consistent throughout the studies examined. Consumption of nuts in the context of a healthy diet did not lead to weight gain.²⁰

Observational studies were also considered and some examples include a large longitudinal study of 120,887 healthy people who were free of chronic disease including obesity at baseline. While participants gained weight over the 30-year trial period (1.5 kg every four years), those who consumed more nuts each day were unlikely to gain weight in the four year period. This may be interpreted as an eating pattern that may help prevent long term weight gain.¹⁴

This relationship was confirmed in another longitudinal study of 51,188 women over eight years found that higher nut consumption – a 30 gram handful of nuts twice a week or more – was not associated with weight gain (P for trend <0.001) and was linked with a 23% reduction in obesity risk (P for trend = 0.003).¹¹

Based on the body of evidence, the researchers found that regular nut consumption does not result in weight gain when eaten as part of a healthy diet.

Of the intervention studies, several demonstrating favourable effects were of particularly high quality, some examples include:

- In a trial of 65 people with pre-diabetes, who followed a diet where 20% of the energy was replaced with almonds (about 60 grams a day) over a 16 week period, significant reductions were found in insulin levels (p = 0.002), insulin resistance (p = 0.007), and LDL cholesterol (P =0.05) with no weight gain.²⁵
- Another trial of 117 people with type 2 diabetes, randomly assigned them to three diabetic diets for a period of three months: one including 75 grams a day of mixed nuts; one including an equal amount (in weight and energy) of muffin; and one including half portions of both. Replacing carbohydrate foods with nuts can significantly improve glycemic control (P < 0.001) and LDL cholesterol (P <0.001) in people with type 2 diabetes, with no adverse effect on weight.²⁶
- In a 24 week randomised control trial of 60 people with metabolic syndrome, including 50 grams of unsalted pistachios daily resulted in a statistically significant improvement in fasting blood glucose (P < 0.04), total cholesterol (P < 0.02), LDL cholesterol (P < 0.006), and markers of inflammation and oxidative stress, all while reducing waist circumference (P < 0.02).²⁷

In the context of a healthy diet, regular nut consumption does not result in weight gain, and consuming this type of dietary pattern is likely to help prevent weight gain over time.



HOW MANY NUTS?

The amount of nuts eaten in the reviewed studies ranged from 15-168 grams of nuts per day making it difficult to determine an exact dose at which nuts have the greatest effect. In considering the recommended amount of nuts to achieve both the heart and weight effects, the researchers considered both the totality of the evidence in the SLR in combination with the current Australian Dietary Guidelines. They concluded 30 grams, or a handful, a day is an appropriate recommendation for heart health benefits that is not likely to lead to weight gain.²⁰



SUMMARY

The SLR found the body of evidence suggests a regular intake of nuts is associated with improvements in several indicators of heart health, including total cholesterol, LDL cholesterol and LDL:HDL ratio with no weight gain.

This relationship between nut consumption and heart health is supported by a moderate to highly consistent association between nut consumption and a reduction in mortality from cardiovascular disease and coronary heart disease.

Bearing in mind that being overweight is also a risk factor for CVD, it is important to note the intake of nuts was not associated with weight gain or unfavourable changes in weight measures including BMI, fat mass and weight circumference.

From a public health perspective, these effects are substantial and carry population level clinical significance. The body of evidence supports a general level health claim that nuts contributes to heart health, when eaten as part of a healthy diet, without weight gain. Recommendations to consume a 30 gram serve of nuts daily is warranted.

The current evidence supports a general level health claim that nut consumption, as part of a healthy diet, contributes to heart health.

Table 4: Consistency of favourable effects found for nut consumption and weight variables in intervention studies

OUTCOME OF INTEREST	CONSISTENCY RATING ON DIRECTION OF FAVOURABLE / NON-DISTINGUISHABLE EFFECT
Weight	High
BMI	High
Body fat % &/or fat mass	High
Waist circumference	High
Waist-to-hip ratio	Moderate
Lean body mass	High



NEW HEART HEALTH RESEARCH

The body of evidence of effects of nut consumption on health continues to grow as more studies and analyses are conducted. Since the systematic literature review was finalised in early 2015, two significant papers have been published that continue to strengthen our understanding of the heart health benefits of nuts.

A meta-analysis, published in the *American Journal of Clinical Nutrition*, concluded that nut consumption was inversely associated with all-cause, CVD and cancer mortality. In the first meta-analysis, of its type, researchers from Italy and USA examined seven studies for all-cause mortality, six studies for CVD mortality, and two studies for cancer mortality with a total of 354,933 participants. Their published meta-analysis showed consistent results in prospective cohort studies for a decreased risk of mortality in individuals with higher nut intakes. Specifically higher nut consumption, around 30 grams of nuts a day, was associated with a reduced risk of death from heart disease by 40%, all causes by 27% and cancer by 14%, when compared to participants who ate nuts less than once a week.²⁸

Nut consumption of around 30g of nuts a day was associated with a reduced risk of death from heart disease by 40%, cancer by 14% and all causes by 27%. *Grosso et al AJCN 2015*²⁸

A second study, published in the *JAMA Internal Medicine*, found people from different ethnic and socioeconomic backgrounds who consume nuts and peanuts tend to have a lower risk of death from cardiovascular disease and overall death.²⁹

Previous research linking nut consumption with lower mortality primarily focused on higher-income, white populations. This study, by Vanderbilt University, USA, was the first to examine these effects in a variety of races and lower socioeconomic groups.

The research was based on three large ongoing cohort studies including more than 70,000 Americans of African and European descent from the Southern Community Cohort Study (SCCS), and more than 130,000 Chinese from the Shanghai Women's Health Study (SWHS) and the Shanghai Men's Health Study (SMHS) over 5-12 years follow up.

Results showed higher daily nut intake (mean 2-13 grams a day, range 2-170 grams a day) was associated with a 21% reduced risk of total mortality (all three cohorts $P < 0.001$ for trend), and cardiovascular disease deaths ($P < 0.05$ for trend in the US cohort; $P < 0.001$ for trend in the Shanghai cohorts). There was also a 30-40% reduced risk of heart disease for all ethnic groups comparing highest to lowest nut consumers. Researchers concluded nuts can be a cost effective measure to improve cardiovascular health.²⁹

NUT NUTRIENT COMPOSITION

Nuts are nutrient dense and rich in bioactive components, many of which contribute to their heart health benefits. An overview of the heart healthy nutrients of tree nuts can be found in table 5.

Fatty acids: The higher levels of monounsaturated and/or polyunsaturated fat and comparatively lower proportion of saturated fat are one of the main contributors to the consistent positive effect nut consumption has on blood lipids. However, an analysis of the effect of nut consumption on total and LDL cholesterol found the reduction to be more than 25% greater than that predicted by the diet's fatty acid profile alone³⁰, which suggests that the favourable effects are likely to be the result of the synergistic effect of multiple bioactive components in addition to the fatty acid profile. Certain nuts (walnuts and pecans) are also good sources of plant omega 3 – alpha linoleic acid - which although different to marine sources of omega 3 does play a role in heart health.³¹

Phytosterols: Nuts contain phytosterols, and phytosterols are associated with reductions in cholesterol levels, through decreasing cholesterol absorption and increasing faecal cholesterol excretion.³²

Amino acids: Nuts contain arginine an essential amino acid which is involved in the synthesis of nitric oxide (NO). NO causes blood vessels to dilate and remain elastic – maintaining endothelial function - and is involved in the prevention of blood clots. Hardening of the arteries and blood clotting can lead to heart disease.³³

Phytochemicals: Nuts contain a variety of phytochemicals with antioxidant potential such as vitamin E, riboflavin, selenium, manganese, copper, zinc and polyphenols. It is this antioxidant action that is thought to have positive effects on lipid oxidation, oxidative stress and platelet function.³⁴⁻³⁸

Fibre: Nuts contain fibre, including soluble fibre, and soluble fibre can assist with reducing blood cholesterol levels by lowering cholesterol re-absorption from the intestine.³⁹

Sodium and potassium: Unsalted nuts are naturally low in sodium and contain significant amounts of potassium. Healthy, varied diets containing low sodium foods such as unsalted nuts can help reduce blood pressure.⁴⁰

Additional mechanisms of action – heart health

A part from lowering total and LDL cholesterol and effects on endothelial function and oxidative stress as noted above, nuts can also increase **LDL particle size**. Large LDL particles are less destructive than small dense LDL cholesterol.⁴¹⁻⁴²

Mechanisms of action for weight outcomes

There are many ways that nuts help management weight:

- **Satiety:** Nut consumption increases satiety likely due to the protein, fat and fibre content of nuts and they release satiety hormones in the intestine.⁴³⁻⁴⁴
- **Increased energy expenditure:** Nut consumption requires more energy for digestion of the nuts.⁴⁵
- **Fat excretion:** Not all the fat in nuts is absorbed with up to 20% lost through faecal fat excretion.⁴⁵ This is due to the resistance of the nut cell walls to digestion.⁴⁶
- **Glycemic index (GI) lowering effect:** Adding nuts to meals with carbohydrate lowers post prandial glycemia creating a low GI effect which also reduces appetite.⁴⁷⁻⁴⁹
- **Reduce insulin levels and increase insulin sensitivity:** Nut consumption reduces insulin levels which may make insulin more effective improving insulin resistance.⁵⁰⁻⁵¹
- **Acceptability of nuts:** One study group in New Zealand has been investigating how regular nut consumption is accepted by participants. The results of their dietary trials suggested 30 grams of nuts were better accepted in the diet than 60 grams per day and had greater compliance. (Acceptance measured by "desire to consume" and "overall liking" for nuts). Thus it would seem the recommended serve of 30 grams a day is easily achievable and enjoyable.⁵²⁻⁵⁵



Table 5: Nutrient composition of raw, unsalted tree nuts

PER 100G	ALMOND	BRAZIL NUT	CASHEW	CHESTNUT	HAZELNUT	MACADAMIA [^]	PECAN	PINE NUT	PISTACHIO	WALNUT	MIXED TREE NUTS
ENERGY (kJ)	2503	2886	2437	724	2689	3068	2973	2925	2389	2904	2754
PROTEIN (g)	19.5	14.4	17.0	3.4	14.8	9.2	9.8	13.0	19.7	14.4	14.6
FAT TOTAL (g)	54.7	68.5	49.2	0.6	61.4	74.0	71.9	70.0	50.6	69.2	63.3
FAT SATURATED (g)	3.7	14.8	8.4	0.1	2.7	10.0	4.5	4.2	5.8	4.4	6.5
FAT MONOUNSATURATED (g)	35.9	21.8	31.1	DU	48.8	59.8	39.3	23.0	26.7	12.1	33.2
FAT POLYUNSATURATED (g)	12.8	29.0	7.5	DU	7.2	3.8	25.0	39.8	15.8	49.6	21.2
FAT OMEGA-3 (ALA) (mg)	0	0	0	DU	120	99	620	0	0	6280	791
CARBOHYDRATE TOTAL (g)	4.8	2.4	16.8	34.3	5.1	7.9	4.9	4.5	6.8	3.0	6.2
CARBOHYDRATE SUGARS (g)	4.8	2.1	5.5	3.8	4.4	4.6	4.3	3.4	5.9	2.7	4.2
DIETARY FIBRE (g)	8.8	8.5	5.9	8.1	10.4	6.4	8.4	5.1	9.0	6.4	7.7
SODIUM (mg)	5.0	2.0	11.0	1.0	3.0	1.4	3.0	3.0	7.0	3.0	4.3
POTASSIUM (mg)	740	560	550	574	680	410	500	600	950	440	603
MAGNESIUM (mg)	260	350	250	33*	160	130*	110	230	100	150	193
ZINC (mg)	3.7	4.1	5.5	0.5	2.2	1.3*	3.9	5.3	2.3	2.5	3.4
COPPER (mg)	1.1	2.0	1.9	0.5*	1.5	0.8*	0.4	1.2	1.4	1.4	1.3
MANGANESE (mg)	2.5	0.8	1.4	1.2*	3.5	4.1*	5.1	6.9	1.1	3.2	3.2
SELENIUM (µg)	3.2	1917*	33	1.2*	1.0	3.6*	2.0	1.0	1.0	2.0	218
VITAMIN E (mg)	28.1	5.3	0.7	0.5*	16.0	0.5*	5.6	12.9	4.1	2.6	8.4
RIBOFLAVIN (mg)	1.4	0.4	0.2	0.1	0.2	0.2	0.2	0.2	0.3	0.2	0.4
ARGININE (g)*	2.4	2.1	2.1	0.2	2.2	1.4*	1.2	2.4	2.0	2.3	2.0
PLANT STEROLS (mg)*	172	96	DU	DU	122	116	159	236	214	110	155
TOTAL POLYPHENOLS (mg GAE/100g)#	418	310	269	DU	835	156	2016	68	1657	1556	809

DU = Data Unavailable

Figures from NUTTAB 2010 unless otherwise indicated below

Energy values include energy values for dietary fibre

Vitamin E values are calculated including alpha, beta and gamma tocopherols except for chestnut US alpha tocopherol data only

Chestnut data based on dry roasted from NUTTAB2010 and roasted from USDA where indicated by *

[^]Macadamia data – Australian Macadamia Society lab analysis 2002 or USDA data where indicated by *

Mixed nuts values are the average excluding those nuts with unavailable data and chestnuts.

*United States Department of Agriculture National Nutrient Database for Standard Reference Release 24, 2012

#USDA Oxygen Radical Absorbance Capacity (ORAC) of Selected Foods, Release 2 (2010) (data for macadamias is dry-roasted, other nuts raw)

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