



NUTS AND HEART HEALTH

A summary of the evidence

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EDITION



Incorporating key findings from an updated systematic literature review



FOREWORD

By Professor Linda Tapsell PhD FDA FNSA AM

In keeping with quality practice in nutrition education and marketing, it is good to see the systematic literature review evidence of nuts for heart health updated. Including around 50 new studies since the 2015 review, the update confirmed the favourable effects of nut consumption on the heart disease risk factors of total and low density lipoprotein (LDL) cholesterol, and the ratio of LDL to high density lipoprotein (HDL) cholesterol. The consistency of this evidence was the same or greater than previously found. Nut consumption continued to be associated with reduced risk of cardiovascular and coronary heart disease with no adverse effects on body weight. Since the review was finalised in late 2018, the body of evidence of effects of nut consumption on health continues to grow as more studies and analyses are conducted. Australians can be even more confident that heart health may be supported by including a serving of around 30g nuts per day in a healthy dietary pattern.

Professor Tapsell has substantive expertise in food and nutrition, and has led a large number of trials at the University of Wollongong assessing the effects of foods and dietary patterns on cardio-metabolic health. Her research funding sources have included the NHMRC, ARC, California Walnut Commission, Nuts for Life and Horticulture Australia Limited.

EXECUTIVE SUMMARY

This report is a summary of the latest evidence on nuts and the important role they play in cardiovascular health. It also incorporates a summary of an updated systematic literature review (SLR) – which when combined with the original literature review, now includes over 150 studies - the findings of which support a general level health claim that daily nut consumption, as part of a healthy varied diet, contributes to heart health.

The body of evidence suggests that a regular intake of nuts is associated with improvements in heart health indicators (total cholesterol, LDL cholesterol and LDL: HDL cholesterol ratio), and a moderate to highly consistent reduction in mortality from cardiovascular disease (CVD) and coronary heart disease (CHD). Given the extent of CVD in Australia and the public health impact, it's imperative that our advice is evidence based.

Solid and consistent evidence supports nuts' position as part of a healthy diet aimed at promoting heart health. We therefore encourage everyone to enjoy a healthy 30g handful of nuts every day.



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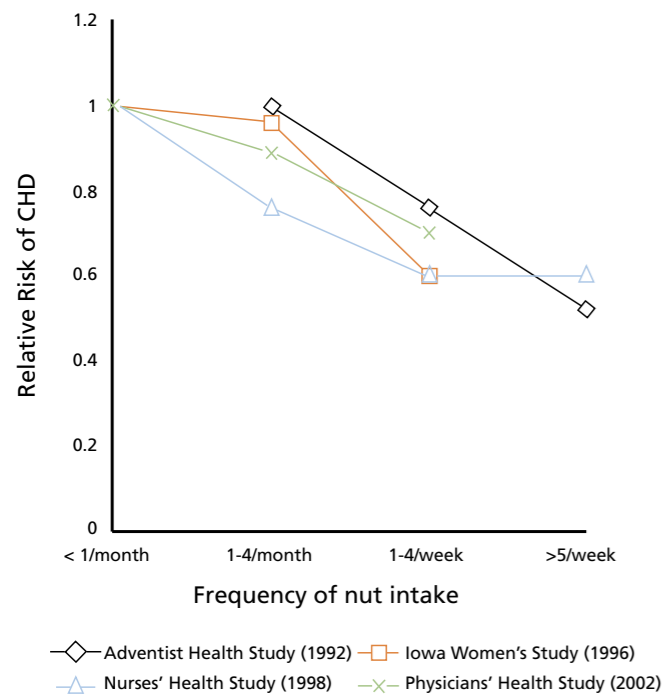
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NUTS AND HEART HEALTH

A LOOK AT THE EVIDENCE

The association between nut consumption and reduced risk of heart disease was first identified more than two decades ago. Four large prospective cohort studies - the Adventist Health Study,¹ Iowa Women's Health Study,² Nurse's Health Study³ and the Physicians' Health Study⁴ indicated an inverse relationship between nut intake and several heart health outcomes including myocardial infarction, CHD and all-cause mortality. The combined evidence from these studies was summarised by Kelly et al⁵ showing that the risk of CHD is 37% lower for those consuming nuts more than four times per week, compared to those who never or seldom consumed nuts. The average reduction of CHD risk was 8.3% for each weekly serving of nuts (Figure 1). Since then, subsequent observational and intervention studies have continued to strengthen the evidence.

Figure 1 – Risk of CHD death by frequency of nut consumption from four epidemiological studies.



A recent combined analysis by Guasch-Ferre et al (2017) investigated the relationship between specific nut types and cardiovascular outcomes in the Nurse's Health Study I, Nurse's Health Study II, and the Physicians Health Follow-up study, and found significantly reduced risk of cardiovascular events for the consumption of walnuts (29% reduction) and tree nuts (19% reduction).⁶

A long-term study undertaken by 16 research groups in Spain, the *Prevencon con Dieta Mediterranea* (PREDIMED trial) is a large multicentre randomised controlled trial which assessed the effect of a Mediterranean diet supplemented with either olive oil or 30g mixed nuts (walnuts, almonds and hazelnuts) per day in older adults at risk of CVD. Both the intervention arms (i.e. olive oil and nuts) proved effective in reducing CVD risk.⁷

A secondary analysis of the PREDIMED study has also explored the impact of nuts on body weight and waist circumference.⁸ Over a five-year period, consumption of a Mediterranean diet supplemented with nuts did not result in significant changes in body weight compared to the control diet, although significantly lower increases in waist circumferences were found over time. While these results cannot be solely attributed to nut consumption, they do suggest that the inclusion of nuts within a healthy dietary pattern does not result in adverse effects on weight outcomes.

More recently, a systematic review and meta-analysis by Guash-Ferre et al⁹ concluded that incorporating walnuts into the diet improved blood lipid profiles without adversely affecting blood pressure or weight. The study included 26 clinical trials with a total of 1,059 participants. Overall, they reported a 3.25% reduction for total cholesterol, a 3.73% reduction in LDL cholesterol, with triglyceride levels also reducing.

Finally, a review of meta-analyses of prospective studies published in December 2018,¹⁰ showed that nut consumption was associated with reduced all-cause mortality by 20%, CVD incidence (19%), and coronary heart disease incidence (20-34%). Nut consumption also had favourable effects on total cholesterol, LDL cholesterol and endothelial function.

SYSTEMATIC LITERATURE REVIEW (SLR)

BACKGROUND

In late 2014, Nuts for Life commissioned researchers from Landmark Nutrition and the University of Wollongong to conduct a systematic literature review to explore the evidence base on the effects of nut consumption on heart health. The body of evidence suggested that there was a causal relationship between the intake of nuts and improvements in several indicators of heart health, with no adverse effect on body weight.¹¹

The 2015 SLR was updated in 2018 to include studies published until March 2018.¹² When combined, a total of 117 intervention studies (136 analyses) providing data on cardiovascular outcomes, and 92 intervention studies (108 analyses) providing data on weight outcomes have been included. A total of 24 and 6 observational studies reporting on cardiovascular and weight outcomes, respectively have also been included. The 2018 update was conducted by Dr Elizabeth Neale, Vivienne Guan, Erika Svensen, Professor Marijka Batterham and Professor Linda Tapsell, from the University of Wollongong.

The updated review demonstrates that the current evidence base continues to support that regular nut consumption is associated with improvements in indicators of heart health. 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.

METHODOLOGY

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 health effects were characterised in terms of heart health indicators and confirmed with cardiovascular and coronary heart disease end points. Heart health indicators included changes in total cholesterol, LDL cholesterol and the ratio of LDL cholesterol to HDL cholesterol. The association between nut consumption and obesity was also examined to ensure any favourable influence on heart health would not be mitigated by a detrimental impact on body weight.

RESULTS

Intervention studies for cardiovascular outcomes

More than one hundred intervention studies have been reviewed in the SLR. Overall, consuming nuts was associated with moderate to highly consistent reductions in total and LDL cholesterol, and in LDL: HDL cholesterol ratio.

- **Total cholesterol:** The consumption of all nut varieties was associated with a moderately consistent reduction/mean change in total cholesterol of 3.28% (-3.28%)[^].
- **LDL cholesterol:** The consumption of all nut varieties was associated with a moderately consistent reduction/mean change in LDL cholesterol of 4.03% (-4.03%)[^].
- **LDL: HDL cholesterol ratio:** Intake of all nuts was associated with a highly consistent reduction/mean change in LDL: HDL cholesterol ratio of 7.38% (-7.38%)[^].
- **Triglycerides:** A moderately consistent reduction/mean change in triglycerides was associated with the intake of all nuts, with a reduction of 6.28% (-6.28%)[^].
- **HDL cholesterol and blood pressure:** A lack of a consistent effect was observed for intake of tree nuts and systolic and diastolic blood pressure and HDL cholesterol.

[^] average is a simple unweighted mean



Table 1: Summary of consistency of effects for tree nuts and 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 |



HOW MANY NUTS?

The quantity of nuts eaten in these studies ranged considerably from 15g to 168g, making it difficult to determine an exact dose at which nuts have the greatest effect. However,

when considering all the evidence and the current Australian Dietary Guidelines, it appears that 30g is an appropriate size.



Observational studies for cardiovascular outcomes

The evidence from 24 observational studies suggests that increased nut consumption is associated with a reduced risk of death from both CHD and CVD (moderate consistency), and associated with a reduced risk of total CVD (high consistency).

Regular nut consumption is associated with a reduced risk of death from heart disease and a reduction in risk factors for heart disease.



Table 2: Summary of consistency of effects for nuts and cardiovascular outcomes in observational studies

| OUTCOME OF INTEREST | CONSISTENCY RATING ON DIRECTION OF FAVOURABLE EFFECT |
|----------------------------------|--|
| Cardiovascular disease mortality | Moderate |
| Total cardiovascular disease | High |
| Coronary heart disease mortality | Moderate |
| Total coronary heart disease | Moderate |
| Stroke mortality | Low |
| Total stroke | Low |
| Hypertension | Low |

“ A regular intake of nuts is associated with improvements in several indicators of heart health, including total cholesterol, LDL cholesterol and LDL:HDL cholesterol ratio, with no weight gain. ”

NUTS AND BODY WEIGHT

Given that one of the risk factors for CVD is overweight and obesity, it was important to review the effects of nuts on weight variables to determine if regular nut consumption would lead to weight gain. A total of 92 interventions and six observational studies were reviewed as part of the SLR, with the body of evidence suggesting that the favourable effects of nut consumption on heart health are unlikely to be mitigated by increases in body weight.

Pooling the results of randomised controlled trials via meta-analysis found non-significant reductions for all anthropometric outcomes, with the exception of waist circumference, where a significant reduction was found. In summary, consumption of nuts when incorporated into a healthy diet does not result in weight gain.

Body weight: Non-significant mean reduction of 0.12kg (based on 69 analyses; 5,546 participants)

Body mass index (BMI): Non-significant mean reduction of 0.06kg/m² (based on 51 analyses; 4,217 participants)

Body fat: Non-significant mean reductions of 0.19% (based on 19 analyses; 1,384 participants) and 0.29kg (based on 13 analyses; 1,257 participants) were found for percent body fat and kilograms of body fat, respectively

Waist-to-hip ratio: Non-significant mean reduction of 0.02 (based on 6 analyses; 458 participants)

Waist circumference: Significant mean reduction of 0.82cm (based on 37 analyses; 3,597 participants).

Consumption of nuts when incorporated into a healthy diet does not result in weight gain.

Table 3: Consistency of effects for all nuts and weight variables in intervention studies

| OUTCOME OF INTEREST | CONSISTENCY RATING ON DIRECTION OF FAVOURABLE EFFECT |
|----------------------------|--|
| Weight | High |
| Body mass index (BMI) | High |
| Body fat % and/or fat mass | Moderate |
| Waist circumference | High |
| Waist-to-hip ratio | High |
| Lean body mass | High |

CONCLUSION

The body of evidence from the SLR 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 CVD and CHD.

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. Therefore, recommendations to consume a 30g serve of nuts daily is warranted.

These effects are substantial and carry population level clinical significance.

MECHANISMS OF ACTION – HOW NUTS CONTRIBUTE TO HEART HEALTH

Nuts are nutrient dense and rich in bioactive components (polyphenols, carotenoids, phytosterols, fibre and minerals), many of which contribute to their heart health and weight benefits.

Fatty acids: The higher levels of monounsaturated and/or polyunsaturated fat and comparatively lower proportion of saturated fat are one of the main known contributors to the consistent positive effect nut consumption has on blood lipid profiles. 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 alone, suggesting that the favourable effects are likely to be the result of the synergistic effect of multiple bioactive components.¹³ Walnuts and pecans also contain plant omega 3 – alpha linoleic acid – which also play a role in heart health.¹⁴

Phytosterols: Nuts are rich sources of phytosterols, which are associated with reductions in cholesterol levels, mediated by decreased cholesterol absorption and increased faecal cholesterol excretion.¹⁵

Amino acids: Nuts contain arginine - an essential amino acid which is involved in the synthesis of nitric oxide. Nitric oxide causes blood vessels to dilate and remain elastic – maintaining endothelial function – and is involved in the prevention of blood clots.¹⁶

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.¹⁷

Fibre: Nuts contain soluble fibre which can assist with reducing blood cholesterol levels by lowering cholesterol reabsorption from the intestine.¹⁸

Nuts and weight: Despite the energy dense nature of nuts and the common perception that nuts cause weight gain, evidence consistently shows that nuts do not adversely affect weight.

- Nut consumption increases satiety, which in turn may be responsible for the dietary compensation at later meals.¹⁹ The effects on satiety are likely due to the protein, fat and fibre content of nuts as well as their influence on appetite hormones cholecystokinin (CCK) and peptide YY (PYY).
- Consumption of nuts has been found to increase energy expenditure, as well as increasing the amount of fat lost through faecal fat excretion. Increases of up to 20% in faecal fat have been reported.²⁰⁻²¹ These findings are thought to be due to the resistance of the nut cell walls to break down during digestion, resulting in greater amounts being excreted. This may also help explain the fact that greater fat losses occur following consumption of whole nuts compared to nut pastes or oils.²¹⁻²⁴ As a result, the metabolisable energy available from nuts has been suggested to be 5-20% lower than that predicted by Atwater factors.²⁵⁻²⁷



NUT CONSUMPTION IN AUSTRALIA

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 5.2g.²⁸ While this represents a 60% increase in the amount of nuts being consumed since the 1995 National Nutrition Survey, nut consumption in Australia still falls a long way short of the recommended 30 gram serve size. The dietary modelling report that underpins the guidelines noted that Australian adults need to increase nut consumption by 350% to reach modelling targets.²⁹

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

The guidelines also provide allowances for the consumption of foods providing unsaturated fatty acids, including an additional 10g 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.

HEART DISEASE IN AUSTRALIA

Cardiovascular disease 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, with 43,477 deaths (27% of all deaths) in 2017.³¹ Despite improvements in the past few decades, it remains one of the biggest health burdens on our economy.³²

Risk factors include high blood pressure, high cholesterol, overweight and obesity, and unhealthy diets. According to the National Heart Foundation of Australia, nearly three-quarters of all Australians aged 30-65 years have at least one risk factor.



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