The role of peanuts in the prevention **of coronary heart disease**

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Epidemiological and clinical trial evidence has demonstrated consistent benefits of nut and peanut consumption on coronary heart disease (CHD) risk and associated risk factors. The epidemiological studies have reported various endpoints, including fatal CHD, total CHD death, total CHD, and nonfatal myocardial infarction.

A pooled analysis of four US epidemiological studies showed that subjects in the highest intake group for nut consumption had a 35% reduced risk of CHD incidence. The reduction in total CHD death was primarily due to a decrease in sudden cardiac death.

Clinical studies have evaluated the effects of many different nuts and peanuts on lipids, lipoproteins, and various CHD risk factors, including oxidation, inflammation, and vascular reactivity. Evidence from these studies consistently shows a beneficial effect on these CHD risk factors.

The LDL cholesterol-lowering response of nut and peanut studies is greater than expected, based on blood cholesterol-lowering equations that are derived from changes in the fatty acid profile of the diet. Thus, in addition to a favourable fatty acid profile, nuts and peanuts contain other bioactive compounds that explain their multiple cardiovascular benefits.

Other macronutrients include plant protein and fibre; micronutrients including potassium, calcium, magnesium, and tocopherols; and phytochemicals such as phytosterols, phenolic compounds, resveratrol, and arginine. Nuts and peanuts are food sources that are a composite of numerous cardioprotective nutrients and if routinely incorporated in a healthy diet, population risk of CHD would therefore be expected to decrease markedly.

Cardiovascular disease

Cardiovascular disease (CVD) is the leading cause of death in developed countries. Progress has been made in reducing death from CVD over the past 25 years. For example, in the US, the CVD mortality rate has decreased by 41% since the early 1980s. This reduction is associated with advancements in treatments as well as prevention.

Related to treatment is the rise in the number of hospital discharges for CVD since the 1970s, related in part to more angioplasties and bypasses being performed. Furthermore, there has been an increase in the incidence of heart failure (i.e. more people are living with progressive heart disease), which reflects advances made in treatment efforts.

With respect to prevention, the population-based decrease in LDL cholesterol (LDL-C) from the mid-1970s to 2002 is a good metric of the progress that has been made in decreasing CVD risk. Despite the 'progress' that has been made in decreasing the prevalence of CVD, the American College of Cardiology recently predicted that by 2050, the number of Americans diagnosed with CVD will double to 25 million.

This projection is troubling because it is predictive of what will likely occur worldwide. Thus, notwithstanding the advancements in reducing CVD death, a focus on prevention is key to a long-term decrease in CVD and the monetary burden associated with contemporary healthcare.

It is clear that lifestyle practices can have a marked impact on the prevention of CVD. Diet remains the cornerstone of prevention efforts and impressive progress has been made in understanding how individual dietary factors, including nutrients and food, and dietary patterns modulate multiple CVD risk factors.

In recent years, tree nuts and peanuts have been shown to have cardioprotective effects and there is a large body of consistent evidence from epidemiological and controlled clinical studies demonstrating their multiple beneficial effects on CVD. This has been the impetus for research to determine the biological mechanisms that account for the cardiovascular benefits reported for nuts and peanuts.

Epidemiological evidence

All epidemiological studies conducted in the US have reported a beneficial relationship between nut consumption and CHD incidence.

Peanut consumption was also associated with lower relative risk of CHD. Subjects who consumed peanuts 21 times per week had a relative CHD risk of 0,66 (CI: 0,46-0,94). For tree nuts, consumed 21 times per week, the relative risk was 0,79 (CI: 0,50-1,25). One mechanism by which tree nut and peanut consumption may decrease CHD risk is by decreasing inflammatory markers, thereby improving inflammatory status.

Inflammation is a key process in atherogenesis, among other diseases. In a cross-sectional study conducted by Jiang *et al*. using data from the Multi-Ethnic Study of Atherosclerosis, consumption of nuts and seeds was inversely associated with levels of inflammatory markers, C-reactive protein (CRP), interleukin (IL)-6, and fibrinogen.

This is important because inflammation contributes to all phases of atherosclerotic disease, ranging from initial recruitment of circulating leukocytes to induced endothelial dysfunction and plaque rupture.

Clinical studies

The benefits of nut consumption on CHD risk reported by epidemiological evidence was the impetus for clinical studies designed to assess the effects on risk factors for CVD and to begin building an understanding of the underlying mechanisms that explained the observational data.

The first study was the Loma Linda University walnut study. Sabate *et al.* evaluated a blood cholesterol-lowering diet that provided 20% energy from walnuts and 31% energy from fat, of which 6% came from saturated fatty acids (SFA) and 16% from polyunsaturated fatty acids (PUFA). This was compared with a standard Step I diet that provided 30% of energy from fat, of which 10% was from SFA and 10% from PUFA.

The most studied nuts have been walnuts and almonds. Some research was conducted on peanuts, pecans, macadamia nuts, hazelnuts, and pistachios. These studies evaluated lipids, lipoproteins, and apolipoproteins. More recently, the effects of nuts on other emerging CVD risk factors were evaluated in clinical trials, including oxidative stress and inflammation.

By virtue of their unique fat and non-fat composition, nuts are likely to affect oxidative stress, inflammation, and vascular reactivity. In nut feeding trials effects on these markers of atherogenesis were studied less than the lipid and lipoprotein CVD risk factors. Nonetheless, the emerging picture is that frequent nut consumption has beneficial effects on CVD risk factors beyond cholesterol lowering.

Nuts and oxidative stress

Nuts are important sources of tocopherols and phenolic antioxidants and protective effects of these dietary constituents on LDL oxidation have been well documented in human and animal studies. Oxidative markers after feeding of MUFA-rich nuts were examined in several clinical trials. Results were inconsistent in studies involving almonds.

Berry *et al.* showed that oxidation of plasma and LDL lipids in healthy volunteers was less after an almond diet compared with a low-fat diet. Jenkins *et al.*, in a dose-response study comparing two doses of almonds with a low-fat diet in hyperlipidaemic subjects, observed a 14% reduction in plasma oxidised LDL levels after the higher dose (average 73g/d).

Diets enriched with peanut oil or peanuts plus peanut butter also improved LDL oxidisability compared with an average American diet rich in fat, but not compared with a low-fat diet.

Remarkably, in all nuts, most of the antioxidants are located in the pellicle or outer soft shell, and 50% is lost when the skin is removed. This fact, rarely taken into consideration in prior feeding trials with nuts, should not be overlooked in future studies.

Walnuts are an exception, because they are almost always consumed as the raw product with skins. Recent studies showed that almond and peanut skins are very high in antioxidants.

Nut intake and inflammation

Plasma high-sensitivity CRP, an accepted measure of systemic low-grade inflammation, was a secondary outcome in several controlled nut feeding trials carried out in hypercholesterolemic subjects with almonds or walnuts. Three studies, two with almonds and one with walnuts, demonstrated a CRP-lowering effect.

However, two other studies reported no significant decrease in CRP. A more statistically powered trial also did not show an effect of the Mediterranean diet enriched with mixed nuts on circulating CRP levels. Then again, the plasma level of IL-6, a potent inflammatory cytokine, decreased after the Mediterranean diet with nuts was compared with the control diet.

Nuts and peanuts in a healthy diet

A healthy dietary pattern is high in fruit, vegetables, nuts, legumes, whole grains, and lean protein sources and low-fat dairy products. Nuts are a popular and important protein source in vegetarian diets. In a cohort of Seventh Day Adventists, Fraser reported that in vegetarians, after soft margarine on bread and green salads, nuts were next on the list of food most frequently consumed.

In fact, nuts were consumed more than meat substitutes. A well-balanced diet that includes nuts and peanuts can markedly benefit health, and in the context of this article, reduce CVD risk.

In summary, there is impressive evidence from epidemiological and clinical trials and *in vitro* studies of beneficial effects of nut consumption and their constituents on the risk of CVD, including sudden death, as well as on major and emerging CVD risk factors. The evidence to date is convincing that including nuts in a heart-healthy diet extends cardioprotective effects beyond those defined for a contemporary heart-healthy dietary pattern.

Importantly, these effects target multiple CVD risk factors and mechanisms, which help to explain why nuts so potently reduce CVD risk. Understanding the underlying biological mechanisms that explain the effects nuts have on multiple CVD risk factors may help in the design of the next generation of diets that include nuts to maximally reduce CVD risk.