

Can altering carbohydrate, protein and unsaturated fat intake improve patients' blood pressure and lipid profile?

Original article Appel LJ *et al.* (2005) Effects of protein, monounsaturated fat, and carbohydrate intake on blood pressure and serum lipids: results of the OmniHeart randomized trial. *JAMA* 294: 2455–2464

SYNOPSIS

KEYWORDS blood pressure, cardiovascular risk, HDL cholesterol, LDL cholesterol, triglycerides

BACKGROUND

A diet similar to that used in the Dietary Approaches to Stop Hypotension (DASH) trial can lower patients' blood pressure and LDL cholesterol levels; however, changes to this diet could benefit patients further.

OBJECTIVE

To compare the effects of a protein-rich diet, a carbohydrate-rich diet—loosely based on the DASH diet—and a diet rich in monounsaturated fat on lipid levels and blood pressure.

DESIGN

The randomized Optimal Macronutrient Intake Trial to Prevent Heart Disease (OmniHeart) enrolled individuals with systolic blood pressure (SBP) 120–159 mmHg and diastolic blood pressure (DBP) 80–99 mmHg. Exclusion criteria included LDL cholesterol levels higher than 5.7 mmol/l (220 mg/dl), triglyceride levels more than 8.48 mmol/l (750 mg/dl) and diabetes.

INTERVENTION

All participants completed 2 days of each of the 3 study diets during a 6-day pretrial phase, after which they were given the three diets for 6 weeks each, in one of six feeding sequences. Participants ate their own food during the 2–4-week washout phase separating each diet. All meals were prepared for the participants and their weight was kept constant by adjusting their caloric intake. Blood pressure was measured at study start, once during the 6-day pretrial phase and once each week during the first 4 weeks of each new diet. The average of five measurements during the last 10 days

of each diet was recorded as final blood pressure. Total triglyceride, total cholesterol and HDL cholesterol levels were measured following an 8 h and 12 h fast at study start, and at weeks 4 and 6 each new diet.

OUTCOME MEASURES

The coprimary outcomes were LDL cholesterol levels and SBP.

RESULTS

In total, 164 individuals completed two or more of the study feeding sequences and were included in the primary analysis. The reductions in SBP and DBP were greater following the protein-based diet than following the carbohydrate-based diet in patients with hypertension and prehypertension (1.4 mmHg reduction in SBP, $P=0.002$, vs 3.5 mmHg reduction, $P=0.006$), as were the reductions in LDL cholesterol (0.09 mmol/l [3.3 mg/dl], $P=0.01$), triglycerides (0.18 mmol/l [15.7 mg/dl], $P<0.001$) and HDL cholesterol (0.03 mmol/l [1.3 mg/dl], $P=0.02$). The unsaturated-fat-based diet also further reduced SBP and DBP when compared with the carbohydrate-based diet (1.3 mmHg reduction in SBP, $P=0.005$, vs 2.9 mmHg reduction, $P=0.02$); however, the blood pressure reductions in prehypertensive patients were not statistically significant. Although the unsaturated-fat-based diet did not lower LDL cholesterol compared with the carbohydrate-based diet, it raised HDL cholesterol by 0.03 mmol/l (1.1 mg/dl, $P=0.03$). Estimated 10-year cardiovascular risk was lower after the protein-based and unsaturated-fat-based diets than after the carbohydrate-based diet (risk reductions 21.0%, 19.6% and 16.1%, respectively).

CONCLUSION

Blood pressure can be reduced and lipid profiles improved by modification of the carbohydrate-based diet by partial substitution of the carbohydrate with protein or unsaturated fat.

COMMENTARY

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Human epidemiological and clinical data and decades of animal experimentation have established the metabolic basis of atherosclerosis. Diet is a major modifier of cardiovascular disease risk, hence the use of foods that improve both lipid and blood pressure profiles in individuals prescribed medical nutrition therapy.¹

Elevated intake of saturated fats, *trans* fats and cholesterol raises LDL cholesterol levels. Furthermore, sodium intake affects blood pressure.² The DASH diet plan—a diet enriched in plant foods, containing reduced sodium, but more potassium, calcium and magnesium than a normal diet—reduces average blood pressure.³ Can this dietary pattern be improved by altering the relative amounts of protein, unsaturated fat and carbohydrate? Presumably greater benefit would result from reduced levels of cholesterol and triglyceride, reduced blood pressure, raised (or less reduction in) HDL cholesterol, and improvement in parameters of insulin action. Reduced levels of surrogate risk factors such as C-reactive protein or other inflammatory cytokines could also be helpful.

Appel and colleagues studied three isocaloric diets: a carbohydrate-rich diet similar to the DASH diet; a diet that replaced 10% of carbohydrate calories with protein calories, mainly plant protein including 7.3 g soy protein daily; and a diet that replaced 10% of carbohydrate calories with monounsaturated fat from olive and canola oils, nuts and seeds. All three diets, compared with the baseline typical North American diet, significantly reduced blood pressure and LDL cholesterol. The high-protein diet had the greatest effect. Triglyceride levels remained unchanged with the carbohydrate-based diet, although they decreased with the unsaturated-fat and high-protein diets. HDL levels decreased when saturated fat and cholesterol were reduced; however, HDL cholesterol was reduced the most with the high-protein diet, the reason for which is unclear.

One of the study's strengths is its use of 'real' foods rather than formula diets. Thus, the study results can be translated into eating patterns that can be recommended to patients. A plant-protein-based diet with decreased intake of simple sugars appears superior to the DASH-

type diet. Because of the complexity of food, we cannot know for sure which dietary components are more beneficial. Specifically, the increase in plant protein in the protein-based diet could have contributed significant benefits. The inferior results seen with the carbohydrate-based diet can be attributed to the increased consumption of simple carbohydrates such as those in juices and sweets; complex carbohydrates such as grains, legumes and vegetables were not increased in this diet.

The long-term effects of these dietary patterns on cardiovascular risk factors, body weight, insulin action and the propensity to develop diabetes and vascular disease are unknown. In addition, it is unclear whether patients will adhere to a specified diet in everyday life. We do not know if the reductions in HDL cholesterol with the protein-based diet are less important than the greater reductions in LDL cholesterol and triglyceride.

Clinicians should note that the most striking effects of these diets were seen when compared with the patient characteristics at baseline. All diets reduced blood pressure and atherogenic lipoprotein levels. Plant-based eating patterns are clearly superior to a diet of the average overweight patient. The goal of clinicians is to recommend a meal plan that improves cardiovascular disease risk factors. This study implies that patients can develop a healthy and individual dietary pattern that best suits their taste.

References

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Competing interests

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PRACTICE POINT

Several modifications of the DASH diet improve cardiovascular risk factors, although a diet based more on protein might be the most beneficial