Editorial comment

Nutrition and metabolism

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The metabolic syndrome ('syndrome X') is characterized by the clustering of atherogenic risk factors, including central obesity, glucose intolerance, hypertension and dyslipidaemia. The clustering of these risk factors is thought to be related to insulin resistance [1]. Weight reduction is important in managing individuals who are obese and have dyslipidaemia, an important element of which is reducing fat intake, particularly reducing saturated fat in the diet, and increasing complex carbohydrate intake. However, little is known about the effects of the amount and type of carbohydrate intake on the risk of coronary heart disease (CHD), although high intake can increase VLDL [2] and reduce HDL [3]. In addition, different types of carbohydrates induce a range of responses in plasma glucose and insulin concentrations, a measure of which is the glycaemic index [4,5].

The impact on risk for CHD of the glycaemic index of dietary intake has been investigated in the large prospective Nurses Health Study [6••]. The Nurses Health Study included a cohort of 75 521 women aged 38–63 years with no previous history of CHD or diabetes mellitus. The final baseline population was established in 1984, and the population was followed for 10 years. The dietary intake was established by a validated questionnaire and was updated on two occasions during the study. The glycaemic index of the diet was calculated from these data. There were 761 cases of CHD (208 fatal) during the period of follow up. After adjustment for age, smoking status and other CHD risk factors, the glycaemic load of the diet was associated directly with coronary risk, the relative risk being 2.77 for the highest quintile. These data suggest that a high dietary glycaemic load, which results from a high intake of refined carbohydrates, increases the risk of CHD independently of other CHD risk factors.

The National Cholesterol Education Programme (NCEP) [7] recommends reducing saturated fat intake to less than 7% of calories in the Step II diet for reducing plasma LDL-cholesterol concentrations. HDL-cholesterol has been reported to decrease more in hypercholesterolaemic women than in men ingesting an NCEP Step II diet for 6 months [8], and these findings have been extended to a 12-month period [9••]. Hypercholesterolaemic individuals were taught the NCEP Step II diet in eight weekly classes and were counselled quarterly. Seventy-three hypercholesterolaemic women (mean age 43 years) and 112 hypercholesterolaemic men (mean age 45 years) were studied. Total fat (24–26% kcal) and saturated fat (7.1–7.9% kcal) intakes at 1 year were similar in both groups. HDL-cholesterol decreased by 7.6% in women ($P < 0.01$), but the decrease (1.3%) was not statistically significant in men. HDL_2-cholesterol decreased 16.7% in women compared with a nonsignificant 0.5% increase in men. LDL-cholesterol and weight did not differ between the groups. The results point to sex-based differences in HDL formation and removal.

The effect of very-low-fat diets on LDL particle size has been investigated in children [10••]. The low-fat, high-carbohydrate diet produced significantly greater decreases in LDL particle size in children whose parents both had small dense LDL, suggesting that such a diet can induce the expression of small dense LDL.

References

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6 •• Liu S, Willett WC, Stampfer MJ, *et al*. A prospective study of glycemic load, carbohydrate intake, and risk of coronary heart disease in US women. Am J Clin Nutr 2000; 71:1455–1461.

7 Sempos CT, Cleeman JI, Carroll MD, *et al*. Prevalence of high blood cholesterol among US adults: an update based on the second report of the National Cholesterol Education Program Adult Treatment panel. JAMA 1993; 269:3009–3014.

8 Walden CE, Retzlaff BM, Buck BL, *et al*. Lipoprotein response to the National Cholesterol Education Program step II diet by hypercholesterolemic and combined hypercholesterolemic women and men. Arterioscler Thromb Vasc Biol 1997; 17:375–382.

9 •• Walden CE, Retzlaff BM, Buck BL, *et al*. Differential effect of National Cholesterol Education Program (NCEP) step II diet on HDL cholesterol, its subfractions, and apoprotein A-I levels in hypercholesterolemic women and men after 1 year. Arterioscler Thromb Vasc Biol 2000; 20:1580–1587.

10 •• Dreon DM, Fernstrom HA, Williams PT, Krauss RM. Reduced LDL particle size in children consuming a very-low-fat diet is related to parental LDL-subclass patterns. Am J Clin Nutr 2000; 71:1611–1616.

Recommended reading

Carlsson M, Wessman Y, Almgren P, Groop L. High levels of nonesterified fatty
• acids are associated with increased familial risk of cardiovascular disease. Arterioscler Thromb Vasc Biol 2000; 20:1588–1594.

This interesting paper addressed the question of whether elevated concentrations of nonesterified fatty acids (NEFAs) are associated with an increased risk of cardiovascular disease. NEFA concentrations were measured in 140 diabetic and 343 nondiabetic unrelated individuals with a family history of type 2 diabetes, and the findings were related to history of cardiovascular disease in their parents. Parents of nondiabetic offspring in the highest quartile of highest NEFA concentrations had a higher risk of myocardial infarction (35% versus 16%; $P<0.01$) and stroke (45% versus 16%; $P<0.0005$) than did parents of offspring from the lowest NEFA quartile. In a multiple logistic regression analysis, a high NEFA concentration in offspring was significantly associated with myocardial infarction and stroke in their parents, no such relationship being observed between diabetic offspring and their parents. The findings suggest that elevated NEFA concentrations are a risk factor for cardiovascular disease.

Clarke SD. Polyunsaturated fatty acid regulation of gene transcription: a
• mechanism to improve energy balance and insulin resistance. Br J Clin Nutr 2000; 83(suppl 1):S59–S66.

The paper provides a useful review, exploring the hypothesis that polyunsaturated fats, particularly n-3 fatty acids, play an essential role in the maintenance of energy balance and glucose metabolism. Dietary polyunsaturated fatty acids appear to direct glucose to glycogen storage and fatty acids away from triglyceride synthesis.

Dreon DM, Fernstrom HA, Williams PT, Krauss RM. Reduced LDL particle size in
•• children consuming a very-low-fat diet is related to parental LDL-subclass patterns. Am J Clin Nutr 2000; 71:1611–1616.

This paper reports an interesting study of the effect of very-low-fat diets on LDL particle size in children. The low-fat, high-carbohydrate diet produced significantly greater decreases in LDL particle size in children whose parents both had small dense LDL, suggesting that such a diet can induce the expression of small dense LDL.

Kasim-Karakas SE, Almario RU, Mueller WM, Peerson J. Changes in plasma
• lipoproteins during low-fat, high-carbohydrate diets: effects of energy intake. Am J Clin Nutr 2000; 71:1439–1447.

This paper is interesting, read in conjunction with the study of Liu *et al.* (2000). Sixty-four postmenopausal women received an initial 4-week period of study in which participants received a diet containing 35% of calories as fat, the energy intake being matched with each participant's energy expenditure. In the following two 6-week periods, fat intake was reduced in a stepwise manner to 25% and then 15% of calories, the intake of carbohydrate being increased to maintain an isocaloric diet. Although LDL-cholesterol was reduced, HDL-cholesterol levels fell (1.76 to 1.50 mmol/l) and plasma triglyceride concentrations increased (1.70 to 2.30 mmol/l). There were no changes in plasma glucose or insulin concentrations.

Lichtenstein AH, Schwab US. Relationship of dietary fat to glucose metabolism.
• Atherosclerosis 2000; 150:227–243.

The authors present a useful review of the relationship between dietary fat and glucose metabolism. High-fat diets result in impaired glucose tolerance, saturated fat appearing more deleterious in causing fat-induced insulin insensitivity than monounsaturated or polyunsaturated fat.

Liu S, Willett WC, Stampfer MJ, Hu FB, *et al.* A prospective study of glycemic
•• load, carbohydrate intake, and risk of coronary heart disease in US women. Am J Clin Nutr 2000; 71:1455–1461.

This paper is important because it includes a large study population of 75 521 women with no previous history of CHD or diabetes mellitus who were followed for 10 years. There were 761 cases of CHD (208 fatal) during the period of follow up. After adjustment for age, smoking status and other CHD risk factors, the glycaemic load of the diet was associated directly with coronary risk. This suggests that a high dietary glycaemic load, due mainly to a high intake of refined carbohydrates, increases the risk of CHD independently of other CHD risk factors.

Riddell LJ, Chisholm A, Williams S, Mann JI. Dietary strategies for lowering
• homocysteine concentrations. Am J Clin Nutr 2000; 71:1448–1454.

Increasing serum homocysteine concentrations are a risk factor for cardiovascular disease. They may be lowered by folate supplements, although data from different approaches to folate supplementation have been lacking. This paper is interesting because the authors compared three approaches to increasing folate intake: folic acid supplements, consumption of folic acid-supplemented breakfast cereals, and an increased intake of folate-rich foods. The supplemented intake for all three groups was approximately 600 μg/day. The reduction in serum homocysteine concentrations was inversely related to the increase in serum folate levels, the greatest increase in serum folate concentrations occurring in the folic acid-supplemented group, and the lowest increase in individuals taking folate-rich food.

Roberts K, Dunn K, Jean SK, Lardinois CK. Syndrome X: medical nutrition
• therapy. Nutr Rev 2000; 58:154–160.

This paper contains a useful review of dietary and lifestyle factors that influence insulin resistance. Specific nutrients are considered, including antioxidants, magnesium, chromium and vanadium.

Simonen P, Gylling H, Howard AN, Miettinen TA. Introducing a new component of
• the metabolic syndrome: low cholesterol absorption. Am J Clin Nutr 2000; 72:82–88.

This paper reports interesting data that show increased cholesterol absorption after weight reduction during low-energy diets. The authors suggest that obese individuals synthesize cholesterol that is secreted into the biliary pool, diluting dietary cholesterol. This dilution is reduced during effective dieting.

Walden CE, Retzlaff BM, Buck BL, *et al.* Differential effect of National Cholesterol
•• Education Program (NCEP) step II diet on HDL cholesterol, its subfractions, and apoprotein A-I levels in hypercholesterolemic women and men after 1 year. Arterioscler Thromb Vasc Biol 2000; 20:1580–1587.

This important study highlights different responses in men and women to the NCEP Step II diet. Hypercholesterolaemic women showed a 7.6% decrease ($P<0.01$) in HDL-cholesterol, the decrease (1.3%) being nonsignificant in men. HDL_2-cholesterol decreased 16.7% in women ($P<0.01$), as compared with a nonsignificant 0.5% increase in men. The results point to sex-based differences in HDL formation and removal.