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Dietary intervention to lower serum cholesterol

Background

Dietary intervention to lower serum LDL-cholesterol (LDL-C) is effective, yet underutilised in general practice.

Objective

This report summarises the findings of an expert roundtable convened to review the evidence relating to dietary interventions to lower serum LDL-C.

Discussion

Interventions that lower LDL-C lower the risk of cardiovascular disease. Comprehensive dietary intervention is indicated in all patients with an absolute 5 year risk for coronary disease of 10% or greater. Short term trials indicate that these interventions have the potential to lower LDL-C by approximately 20%. A year long trial has shown mean LDL-C lowering of 13%, with about one-third of subjects achieving a reduction greater than 20%, highlighting the importance of adherence to dietary advice. The most effective dietary strategies are replacing saturated and trans fatty acids with poly- and mono-unsaturated fats and increasing intake of plant sterols. Losing weight and increasing soluble fibre and soy protein intake can also lower serum cholesterol and may be considered when recommending a nutritionally balanced, cholesterol lowering diet. Motivational interviewing by general practitioners can improve the effectiveness of brief, behaviour orientated advice and dietary counselling to lower serum cholesterol.

■ It has been known for decades that raised total cholesterol and serum LDL-cholesterol (LDL-C) are associated with increased risk of coronary disease.¹ Population studies conducted as part of the Asia-Pacific Cohort Studies Collaboration (APCSC) suggest a doubling of relative coronary risk in the highest versus lowest quartiles of LDL-C.² There is also a definite, though less profound, rise in stroke risk associated with increasing cholesterol.³ Randomised, controlled dietary trials to lower LDL-C,^{4,5} conducted in the 1960s and 1970s, lowered coronary event rates. More recently, many studies with statins have demonstrated a cardiovascular benefit from lowering LDL-C, with more aggressive LDL-C reduction producing the greatest benefits. Although most studies have been conducted in middle aged males, all patients at high risk of cardiovascular disease appear to benefit from cholesterol lowering, irrespective of the initial cholesterol concentration.⁶

Low serum HDL-cholesterol (HDL-C) was found to be a strong predictor of cardiovascular disease in the APCSC,² which is consistent with the findings of many other studies. Although raising low HDL-C concentrations above 1 mmol/L has not been clearly demonstrated to lower coronary risk, it is currently recommended by the National Heart Foundation based on consistent epidemiological data.⁶ In certain subgroups, particularly those with low HDL-C, serum triglycerides are predictive of coronary events.

As with pharmaceutical intervention,⁶ LDL-C is the major therapeutic target for dietary intervention. The effects of diet on HDL-C may also be important – though this gives rise to considerable debate, as the effects of macronutrients on HDL-C differ significantly.⁷ The total-HDL-C ratio may provide the best estimation of lipid related risk and this ratio is used in absolute risk calculations.

Applying absolute risk in dietary intervention

Treatment guidelines are moving toward using absolute risk and away from using lipid concentrations to determine who should be recommended for treatment.^{6,8-10} According to the National Heart

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Foundation of Australia, the currently accepted cardiovascular risk to initiate drug therapy is a 15% or greater 5 year risk of a cardiovascular event.⁶ As many cardiovascular events occur in patients below this threshold, there is a need for comprehensive dietary intervention for those at moderate coronary risk (10–15% over 5 years) and general diet and lifestyle advice for those at lower levels of absolute risk (*Table 1*).

What is comprehensive dietary intervention?

Comprehensive dietary intervention has been demonstrated to lower serum LDL-C by 20% in short term interventions in which adherence is maximal.^{11,12} A year long trial has shown mean LDL-C reduction of 13%, with about one-third of subjects achieving a reduction greater than 20%, highlighting the importance of adherence to dietary advice.¹³ The majority of the cholesterol lowering effect may be achieved by substituting unsaturated fats for saturated fats and increasing intake of plant sterols to at least 1.5 g/day. Each strategy has the potential to lower LDL-C by about 10%. (In the case of fat substitution, the potential for reduction will depend on the saturated fat content of the initial diet.) Further cholesterol lowering is also possible through weight loss and increasing intake of soluble fibre and soy protein.

Substituting saturated fats

More than 50 years of scientific research into the effects of dietary fat on serum total-C, LDL-C, and HDL-C concentrations shows convincingly that changing the type of fat consumed in the diet can produce a serum lipid profile associated with lower coronary risk. The results of meta-analyses have been remarkably consistent.^{7,14,15} Relative to carbohydrate, it has been shown that:

- saturated fat raises total-C, LDL-C and HDL-C
- trans fatty acids raise total-C and LDL-C, and lower HDL-C. The HDL-C lowering effect of trans fats implies they are more detrimental to cardiovascular health than saturated fats¹⁶
- polyunsaturated fats lower total-C and LDL-C, and raise HDL-C
- monounsaturated fats have a neutral effect on total-C and LDL-C, and raise HDL-C.

Replacing saturated and trans fats with unsaturated fats is therefore a key strategy for lowering serum LDL-C. Substitution with polyunsaturated fat will achieve the largest reduction in serum LDL-C and in the total-HDL-C ratio: replacing 5% of energy as saturated fat with polyunsaturated fat lowers serum LDL-C by 0.26 mmol/L, compared to a 0.20 mmol/L reduction from an equivalent substitution with monounsaturated fat.⁷ Polyunsaturated fats may also lower coronary risk via other mechanisms.¹⁷ When carbohydrate is used to

Table 1. Absolute risk and intervention

Absolute 5 year risk of a cardiovascular event	Intervention
>15%	Drugs and comprehensive dietary intervention
10–15%	Comprehensive dietary intervention
<10%	General diet and lifestyle advice

replace saturated and trans fats, serum LDL-C falls by a similar extent to that achieved with monounsaturated fat; however this substitution has little effect on the total-HDL-C ratio.

Although the effect of trans fatty acids on serum lipids is more detrimental than that of saturated fat, the emphasis should be on replacing saturated fat, which is present in the Australian diet in amounts approximately 20 times greater than that of trans fats. The three major sources of saturated fat in the Australian diet are:

- dairy products, including butter, cheese and ice cream (27%)
- red meats, poultry and meat dishes (20%), and
- biscuits, cakes and pastries (20%).¹⁸

Patients should be advised to replace full fat dairy foods with low fat and reduced fat equivalents; to choose lean meats and poultry; and to limit their consumption of biscuits, cakes and pastries.

Should total fat intake be lowered?

A reduction in total fat intake without altering the proportions of saturated, polyunsaturated, monounsaturated and trans fatty acids has little effect on serum cholesterol profiles.¹⁴ The best evidence of this comes from the Women's Health Initiative (WHI), in which a low fat dietary intervention trial involving 48 835 women followed up for a mean of 8.1 years showed only small changes in total-C and LDL-C, despite large changes in total fat intake.¹⁹ The polyunsaturated to saturated fat ratio of the diets was unchanged; women in the low fat group simply ate less of the same type of fat as women in the comparison group. This suggests that unless the type of fat in the diet is changed, reducing total fat intake from current levels (about 33% of energy) to as low as 24% of energy has negligible effect on serum cholesterol concentration. (It should be noted however, that the small changes in weight and lack of change in HDL-C in this study suggest the total fat reduction may not have been as great as reported.)

Increasing plant sterols

Plant sterols and stanols are structurally similar to cholesterol and exist naturally in plant foods, notably vegetable oils. Typical consumption is approximately 200–400 mg/day. Plant sterols have been shown to

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inhibit the uptake of both dietary and biliary cholesterol from intestinal cells,²⁰ which results in a decrease in serum total-C and LDL-C concentrations.^{21,22} Serum HDL-C and triglycerides are not affected by dietary plant sterol consumption. A recent meta-analysis indicates a curvilinear dose ranging effect exists between intakes of 1–4 g/day for LDL-C lowering.²³ At doses less than 1.5 g/day, the average effect size is considered to be 0.25 mmol; at doses greater than 2.5 g/day, the effect size increases to 0.42 mmol. Given the modest additional benefit of increasing the dosage above 1.5 g/day, the optimal level of intake to realise a significant health gain is considered to be the lower amount. Plant sterols have been shown to be effective when combined with statin drugs²⁴ and other dietary factors known to lower serum cholesterol,^{25,26} with the exception of ezetimibe.

Patients consuming 1.5–2.0 g/day of plant sterols may experience a fall in serum beta carotene concentrations of 8–19%. This is within the normal variation of this parameter, but can be negated if an extra serve of a beta carotene rich fruit or vegetable is consumed each day.²⁷

Additional cholesterol lowering strategies

Weight loss in those who are overweight lowers serum total-C, LDL-C and triglycerides and increases HDL-C, with every kilogram of weight loss being associated with a 0.02 mmol/L decrease in LDL-C.²⁸ Although HDL-C may fall during active weight loss, if weight loss is maintained it increases to above the initial concentration. Weight loss also lowers the increased risk of acute coronary events in these patients.²⁹

Increasing intake of soluble fibre – found in fruit, vegetables, legumes, psyllium and oats – has been shown to help lower serum LDL-C. The effect is small, however, the consumption of 3 g/day (equivalent to three serves of rolled oats) results in a fall in LDL-C of approximately 0.13 mmol/L.³⁰ The hypocholesterolaemic effect of legumes appears to be related, but not limited to, their soluble dietary fibre content.³¹

Increasing soy protein has been recommended for cholesterol lowering, although estimates of the potential of soy protein to lower cholesterol have recently been revised downward.³² A minimum of 20 g soy protein per day, the equivalent of one cup of soy milk plus half a cup of tofu, appears to be required to achieve LDL-C lowering.

Limiting dietary cholesterol lowers serum total-C and LDL-C, although the effect is small and depends on the ratio of polyunsaturated to saturated fat in the diet. It also varies considerably between individuals.³³ Limiting saturated fat intake effectively lowers dietary cholesterol intake.

Other components of a heart healthy diet

Although not cholesterol lowering, there are a number of dietary components that may be protective against cardiovascular disease through known and unknown mechanisms and their consumption may be encouraged as part of a cholesterol lowering, cardiovascular protective diet. These include oily fish, wholegrains, fruit, vegetables and nuts. Low intake of alcohol may also be encouraged, as may the lowering of dietary sodium intake, which will lower blood pressure.

The key elements of comprehensive dietary intervention to lower LDL-C, in the context of a nutritionally balanced, cardioprotective diet, are summarised in *Table 2*. Examples of simple diet alternatives that will help optimise fatty acids and plants sterols are highlighted in *Table 3*.

GP advice on dietary change

Although more than 80% of patients report that dietary advice from the GP is useful or very useful,³⁴ many GPs remain ambivalent about providing such advice. This may be due to perceptions that such advice is limited in its effectiveness, that patients are uninterested or not motivated to change their diets, or it may relate to the perceived time required to counsel patients. Nevertheless, there is evidence that using a motivational interviewing approach can improve the effectiveness of brief, behaviour orientated advice and counselling for dietary change.³⁵

Table 2. Key elements and cholesterol lowering potential of comprehensive dietary therapy

Major cholesterol lowering strategies	Potential for LDL-C reduction
<ul style="list-style-type: none"> Replacing saturated fat with unsaturated fats Increasing plant sterol intake to >1.5 g/day 	10% 10%
Additional cholesterol lowering strategies <ul style="list-style-type: none"> Losing weight (if appropriate) Increasing soluble fibre intake Increasing soy protein 	6% ~3% ~3%
Other components of a heart healthy diet <ul style="list-style-type: none"> Oily fish Wholegrain breads and cereals Plenty of fruit and vegetables Nuts Low alcohol intake (if patient chooses to drink) 	0 0 0 0 0

Table 3. Dietary alternatives for optimising fats and plant sterols

Foods to include	Foods to limit
Low fat milk, cheese and yoghurt, including plant sterol enriched versions	Full fat cheese, cream, ice-cream, milk and yoghurt
Plant sterol enriched margarine, poly- and mono-unsaturated table margarines	Butter
Sunflower, canola and olive oils (rich in poly- and mono-unsaturated fats)	Solid frying fats
Lean meats and poultry, oily fish and legumes	Fatty meats and poultry, sausages, fatty luncheon meats
Nuts, fruits and vegetables	Biscuits, cakes and pastries
Snack foods and takeaway foods cooked in unsaturated vegetable oil (eg. sunflower)	Most snack foods, most deep fried take aways foods

Table 4. Key principles of motivational interviewing

- Adopting a patient centred approach
- Expressing empathy, promoting autonomy and encouraging mutual participation
- Letting the patient decide how much of a problem they have
- Developing patient discrimination relative to the discrepancy between goals and current problem behaviour using the patient's own expressed benefits (likes) and costs (dislikes) associated with health related behaviour
- Avoiding arguments by assuming that the patient is responsible for the decision to change
- Rolling with resistance rather than confronting it, and supporting self efficacy and optimism for change

Motivational interviewing

Motivational interviewing draws upon a number of psychological processes and can be defined as a 'patient centred, directive method for enhancing intrinsic motivation to change by exploring and resolving ambivalence'. Key principles of motivational interviewing³⁶ are listed in Table 4. There is a considerable body of research in clinical trial settings that supports the effectiveness of motivational interviewing techniques in assisting patients to change diet related behaviour of patients.³⁵ Patient motivation to change is increased if perceived benefits outweigh the costs of remaining the same.³⁶

The 5As approach

A key challenge in improving GP counselling relative to dietary change is providing a clear framework for its implementation. One possible guide is the 5As approach. There is good evidence to support the use of the 5As – ask, assess, assist, advise and arrange – in the primary care setting to assist patients with lifestyle change. Other key behavioural elements that have supportive evidence for dietary change include:

- goal setting
- incremental change
- self monitoring
- stimulus control
- cognitive restructuring, and
- relapse prevention.³⁷

The Royal Australian College of General Practitioners has published prevention implementation guidelines that provide a possible framework to facilitate uptake of effective counselling techniques. These guidelines include motivational interviewing and the 5As.³⁸

Referral to an Accredited Practising Dietitian

Given the time pressures in general practice, it is surprising that only a quarter of GPs consider referring patients requiring dietary advice to dietitians. Dietitians working in partnership with GPs offer an opportunity to achieve successful outcomes from dietary interventions. Because patients are frequently required to bear the full cost of a dietetic consultation however, financial circumstances may serve as a barrier to many in need of these services. Although the Commonwealth Government Enhanced Primary Care program provides Medicare rebates to some patients with chronic illness to see an Accredited Practising Dietitian, access remains limited.

Conclusion

Comprehensive dietary intervention to lower serum LDL-C is indicated in all patients with an absolute 5 year risk for coronary disease of 10% or greater. The most effective dietary strategies are replacing saturated and trans fatty acids with unsaturated fats and increasing intake of plant sterols. Losing weight and increasing intake of soluble fibre and soy protein can also lower LDL-C. Optimal LDL-C lowering through dietary change is more likely to be achieved if GPs employ motivational interviewing to improve the effectiveness of brief dietary counselling.

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to form this report. There were six observers: Trevor Mori (AAS), Jeff Cohn (AAS), Claire Emanuel (DAA), Peter Talbot (DAA), Megan Cobcroft (UA) and Meaghan Ramsay (UA).

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