reduction of cardiovascular mortality and/ or CVD incidence are presented in Table 1. Few primary intervention trials have included changes in diet as the only intervention[98-100]. In the study by Dayton et al[98], the effects were examined of two diets containing about 40% of energy from fat, but with less SFAs and more PUFAs in the experimental diet than the control diet. The experimental diet, which contained 35 to 40% of total fat intake, each of linoleic and oleic acid, reduced serum cholesterol by 12.7%. The experimental diet was associated with a 31% reduction in all atherosclerosis related events There was little difference in total mortality rates, however.

Another of the diet-only primary intervention studies was the Finnish Mental Hospital Study[100]. The mortality from CHD and other causes was studied in a controlled trial with cross-over design. In one hospital a cholesterol lowering diet was introduced, with a PUFA to SFA ratio of 1.42 to 1.78, and in the other hospital a usual diet, with PUFA to SFA ratio of 0.22 to 0.29, served as the control. After six years, the diets were reversed and the trial continued for a further six years. In men, the high PUFA diet was associated with reduced mortality from CHD. Total mortality was also lower on the experimental diet, but not significantly. For women, the differences for both CHD mortality and total mortality were not significant.

In a study by Frantz et al[99], two diets with similar total fat (39% [control] and 38% [treatment]) and MUFA (16% and 18%) intakes, but with differing SFA (18% and 9%), PUFA (5% and 15%) and cholesterol (446 mg and 166 mg) intakes, were compared with respect to CVD events, CVD mortality and total mortality. No differences were observed for any of the end points between the two diets.

Other dietary intervention trials aiming for a reduction in CVD incidence and/ or mortality have considered other CVD-risk factors as well as dietary change, where the effect of dietary change is often confounded with other factors.

Secondary intervention trials

Several secondary intervention trials have been conducted (Table 2). In three of the most successful of these trials, in relation to CVD events, CVD mortality and total mortality, the aim of the successful intervention was to alter the intake of a particular food, foods or diet in general[101-103]. Most of the studies which have failed to show a reduction in events or mortality used an intervention which focused on reducing total fat or increasing the P:S ratio[104-107].

Table 2. Secondary prevention trials of dietary intervention aiming for a reduction in cardiovascular mortality or incidence.

Study/ author	Randomised	Study Population	Diet	Cholesterol Reduction	Major Findings
Morrison[114] 1955	No	100 subjects aged 40-79 years	Low fat	29%	Reduced mortality
Rose et al al 1965	Yes	52 subjects aged <70 years	Low fat added corn and olive oils	Corn oil 20% Olive oil no change	No reduction in mortality between the groups
MRC 1965	Yes	252 subjects aged <65 years	Low fat	8% (3 years)	No reduction in morbidity or mortality
MRC 1968	Yes	393 subjects aged <60 years	High P:S ratio soya-bean oil(2.0)	17% (at 3 years)	Reduced relapse rate No reduction in cardiovascular mortality, or total mortality
Leren[115] 1970	Yes	412 subjects aged 30-64 years	High P/S ratio (2.4)	14% (5 years)	Reduced mortality due to myocardial infarction. No difference in total mortality
Bierenbaum[116] et al 1973	No (matched controls)	200 subjects aged 30-60 years	High P:S ratio. (2.6)	10% (10 years).	Reduced mortality from myocardial infarction. And reduced total mortality
Woodhill et al 1978	Yes	458 subjects aged 30-59 studied for 2-7 years	High P:S ratio (1.5)	Intervention. 11%. Controls 7%	No difference in mortality
Burr et al 1989	Yes	2033 men studied for 2 years	Low fat, high fibre, or increased fish intake		29% reduction in all cause mortality in those on the increased fish intake
Singh et al 1992	Yes	406 subjects	Advice to eat fruits, nuts, vegetables, pulses, & fish	Intervention 13% Controls5 %	39% reduction in cardiac events, 45% reduction in total mortality
de Logeril et al 1994	Yes	605 subjects	Advice to eat a "Mediterranean" diet, high in bread, fruit, vegetables & fish; less red meat; butter & cream replaced with high 18:3ω3 margarine	Intervention 5% Control 5%	Significant reduction in CVD deaths & total mortality

In a randomised controlled study by Burr et al[101], the effects of dietary intervention on secondary prevention of myocardial infarction were examined. It was found that an increased intake of fatty fish reduced 2 year all causes mortality by 29%. In another secondary prevention study in patients with recent MI, CVD events and total mortality were significantly reduced with dietary intervention[103]. The dietary intervention which was associated with lower mortality was advice to include more fruit, nuts, vegetables, grain products, and fish in the diet. This advice was associated with significantly lower SFA and MUFA intakes, and significantly higher PUFA intake, as well as a significant reduction in weight. Other macronutrient and micronutrient differences were also observed[103]. In the study by de Logeril[102], mortality was significantly lower in an intervention group who were encouraged to adopt a "Mediterranean-type" diet: more bread, root vegetables, green vegetables, fruit and fish; less red meat; and with butter and cream to be replaced by a canola oil based margarine high in α-linolenic acid (C18:3ω3). After intervention, this group consumed significantly less fat, SFAs, cholesterol, and linoleic acid, and more oleic and α-linolenic acid. The authors contributed much of the reduction in mortality to the increased α-linolenic acid, however, other dietary changes are likely to have contributed to the reduced mortality. The mechanisms for the observed reductions in total mortality in the studies by Burr et al[101], Singh et al[103] and de Logeril et al[102] may have been many and related to the effects of ω3 fatty acids on blood factors, arterial wall function and myocardial function (Fig. 1). Alterations in lipoproteins and atherosclerosis may have been involved, but were probably less important than other pathways.

Recently Truswell[108] performed a meta-analysis on dietary intervention studies and their effects on CVD events, CVD mortality and total mortality. Although most have failed to show a significant effect of intervention on CVD mortality or total mortality, it was estimated from this analysis that the relative risk of death from all causes was 0.94 (95% CI: 0.894-0.988), a significant reduction. The intervention in these trials varied, and included low fat, altered fat, increased fish, altered diet in general, smoking cessation or exercise, or a combination of these. It is therefore difficult to attribute the reduced mortality to specific dietary factors. However, the results do suggest that dietary intervention can reduce total mortality.

Foods and cardiovascular disease. prospective studies

Prospective studies have shown that many dietary interventions can favourably influence serum lipid and lipoprotein concentrations. Diets low in total and SFAs, and with sufficient ω6 and ω3 PUFAs; relatively high in carbohydrate and protein; low in alcohol; and with a variety of plant foods with various lipid lowering properties will favourably modify most dyslipidaemias. Prospective studies also show that people who have a higher energy intake[109-112] indicative of greater physical activity, a high plant food intake[109], and a higher intake of fish[113] have lower risk of CVD.

Conclusion

It is evident from intervention studies that diet can influence hyperlipidaemia. A positive energy balance, characterised by obesity and abdominal obesity, is one of the most powerful factors in increasing serum LDL cholesterol and triglyceride concentrations, and decreasing HDL cholesterol concentration. Of the macronutrients, dietary fat has the most potent effect. A reduction in the intake of SFAs and TFAs, and an increase in the intake of PUFAs, have favourable effects on LDL and HDL cholesterol, and triglyceride concentrations. Other macronutrients can also have significant effects on lipoproteins. High carbohydrate diets reduce LDL cholesterol and HDL cholesterol, and may increase triglyceride levels. Some of these effects may be secondary to changes in dietary fat intake. It is still not clear whether the type of protein in the diet can have significant effects on serum cholesterol and triglyceride concentrations. Soluble fibres appear to favourably affect serum LDL cholesterol, and some may increase HDL cholesterol and lower triglycerides. Numerous non-nutrient components of food have been identified as having minor lipid lowering properties. Cumulatively, these may be important in the overall diet.

Diet has also been shown to alter CVD risk. The mechanisms involved may be many, and relate to factors other than hyperlipidaemia. Where a reduction in total fat intake is achieved by a reduction in dietary SFAs, there would appear to be a favourable effect on CVD events and mortality, although the evidence for this from intervention studies is not strong. The mechanisms implicated here are probably related to the hyperlipidaemia-atherosclerosis link. Higher dietary PUFA intake, of both ω6 and ω3, may be associated with reduced risk for CVD events, perhaps more through thrombosis and other processes than atherosclerosis. The effects of dietary intervention with carbohydrates, protein, alcohol, fibre, various micro-nutrients, or different non-nutrients, on coronary and total mortality is virtually unknown. There is, however, growing evidence that higher plant food intakes, and therefore carbohydrate intakes, may favourably influence CVD. In relation to food, results of secondary intervention studies provide support for a beneficial role of plant food and fish in reducing coronary and total mortality. This view is supported by results of prospective studies. Therefore as far as both hyperlipidaemia and CVD are concerned, the total dietary approach may be more important than the single nutrient approach.

Diet, hyperlipidaemia and cardiovascular disease

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膳食、高脂血症及心血管疾病

摘要

本文評論了膳食與高脂血症或膳食與心血管疾病（CVD）間的關係。減少飽和脂肪酸（SFAS）和反式—脂肪酸（TFAS），並增加多不飽和脂肪酸（PUFAS）的進食，對脂蛋白狀況有利。雖然研究數據仍未充足牢固，但以減少膳食飽和脂肪酸來達到降低總脂肪進食，將對心血管疾病和死亡率產生有利的影響。進食足夠的多不飽和脂肪酸，包括 W_6 和 W_3 脂肪酸也許會使心血管疾病的危險減少。雖然碳水化合物、蛋白質和酒精對冠心病和總死亡率的影響仍未明確，但這些宏量營養素能對脂蛋白有明顯影響是肯定的，食物中具輕微降脂類特性的非營養素成份在總體膳食中也許是重要的。與食物有關，植物性食物和魚類在減少冠心病和總死亡率起到有益的作用是得到研究的支持。所以就高脂血症和心血管疾病而論，整體膳食的探討也許較之單一營養素的探討更爲重要。

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