

Very Low Fat Diets

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Current dietary guidelines from both the American Heart Association¹ and the National Cholesterol Education Program² recommend restricting consumption of fat to an upper limit of 30% of daily caloric intake. This limit translates into 67 g of fat for small or sedentary individuals who need 2000 calories per day and 100 g of fat for larger or more active individuals who need 3000 calories per day. With the exception of the World Health Organization Study Group,³ which recommends that 15% of total calories be derived from fat, current guidelines do not specify a lower limit on fat intake. Recommending a lower limit is controversial^{4,5} because of the difficulty in balancing the efficacy of a very low fat diet in decreasing plasma cholesterol levels against the risks of nutrient inadequacy or other adverse effects. Some population subgroups, such as growing children, pregnant women, lactating women, and the elderly, have special needs for essential fatty acids and caloric density. Because weight loss frequently accompanies the initial adoption of a very low fat diet and independently affects blood lipid levels and cardiovascular risk, assessing the effect of the very low fat diet alone is difficult. Step 1 and Step 2 diets are effective in lowering blood cholesterol levels⁶⁻⁸ and consequently are advocated as the primary dietary strategy for reducing cardiovascular risk.^{1,2}

This statement summarizes the evidence regarding the association of very low fat intake with reduced cardiovascular risk, the quality and quantity of results bearing on this issue, and the effect of very low fat diets on blood lipid levels in the context of potential body weight changes. The statement also contrasts the benefits of very low fat diets with the potentially harmful effects on certain subgroups.

Definition of a Very Low Fat Diet

For the purposes of this statement, a very low fat diet is defined as one in which $\leq 15\%$ of total calories are derived from fat (33 g for a 2000-calorie diet, 50 g for a 3000-calorie diet) with fat calories distributed approximately equally among saturated, monounsaturated, and polyunsaturated fatty acids. Approximately 15% of total daily calories consumed should be derived from protein and $\geq 70\%$ from carbohydrates.

Epidemiological Studies

Data from free-living populations with naturally selected very low fat diets are becoming increasingly scarce. Almost 3

decades have passed since publication of the Seven Countries Study report,⁹ in which Keys and colleagues showed that saturated fat intake was the strongest predictor of cardiovascular disease mortality. The Ni-Hon-San Study¹⁰ reported that native Japanese derived 15% of calories from fat; migrant Japanese residing in Honolulu, 33%; and migrant Japanese residing in California, 38%. The higher fat intakes in the latter 2 groups were associated with higher rates of cardiovascular disease. As with much of the available data, confounding due to greater body weights makes interpretation of these results difficult. Differences in body weight may be due to differences in other lifestyle factors, such as activity levels or food availability, and cannot be attributed to fat content of the diet alone.

In Japan, intakes of total fat, saturated fat, and calories have increased since the 1950s.¹¹ Current fat consumption is now $>20\%$ of caloric intake.¹² Increased dietary fat may be contributing to the increased incidence of certain cancers in Japan. Serum cholesterol levels have also increased, but age-adjusted cardiovascular mortality rates have remained stable or even decreased slightly since the 1970s.¹¹ The absence of an increase in cardiovascular mortality may be due to improved detection and treatment of cardiovascular disease and reduced levels of hypertension.

Similar findings have been reported in Taiwan, where fat intake increased from 16% of total calories in 1950 to 34% to 36% of total calories in 1987,^{13,14} with the increase primarily in saturated fat intake. Although LDL cholesterol (LDL-C) and triglyceride (TG) levels increased concomitantly, mean levels of these blood lipids remained below those in the US population reported in the Third National Health And Nutrition Examination survey (NHANES III),¹⁵ possibly because of the still relatively favorable polyunsaturated:saturated ratio (1:3) in Taiwan,^{13,14} low rates of obesity, or higher levels of physical activity.

Other populations consuming very low fat diets include vegans and those following Zen macrobiotic diets. These diets tend to be low in saturated fat and high in complex carbohydrates and fiber. Other health-related behaviors that accompany these dietary patterns confound comparisons with groups consuming higher amounts of fat.^{16,17}

Intervention Studies

Serial angiographic evaluation has been used in intervention studies to investigate very low fat diets in patients with atherosclerosis. Subjects participating in the Heidelberg Trial¹⁸ were instructed to reduce fat intake to $<20\%$ of calories and cholesterol to <200 mg/d and to exercise at home for 30 min/d and in a group for 2 h/wk. After 6 years, LDL-C levels were reduced by 6% in the intervention group and elevated by 1% in the control group; HDL cholesterol (HDL-C) levels were elevated by 14% in the intervention

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group and 12% in the control group; relative stenosis diameter remained essentially unchanged in the intervention group (59% versus 62%) and worsened in the control group (55% versus 67%). Because body mass index was unchanged in the intervention group and increased by 4 kg in the control group, in part because of different levels of physical activity, it is difficult to assess the effect of the very low fat diet alone.

Patients in the Lifestyle Heart Trial¹⁹ reported consuming 7% of calories from fat. LDL-C fell by 16%, with no change in HDL-C. After 1 year, coronary lesions regressed in 82% of the intervention group. However, because vigorous exercise, stress reduction, and a mean weight loss of 11 kg accompanied these dietary changes, it is not known to what extent these results were due to the very low fat diet.

Participants in the resident component of the Pritikin Longevity program had similar responses.²⁰ Their diets contained <10% of calories from fat (<3% saturated), 35 to 40 g of dietary fiber per 1000 kcal, and 25 mg of cholesterol per day. Participants also engaged in vigorous physical activity. Beyond response to drug therapy, investigators estimated that total cholesterol was further reduced by 19% within 3 weeks as a result of diet. The effect of accompanying weight loss or long-term compliance was not addressed.

The results of these studies appear impressive, but many questions remain about long-term efficacy and safety. Numbers of subjects are small, follow-up is limited, concerns about long-term nutrient adequacy persist, and extrapolation to the general population is questionable. The independent effects of weight loss and nonquantifiable effect of accompanying lifestyle interventions complicate interpretation.

Clinical Studies

Blood Cholesterol Levels

Reducing the fat content of the diet from 35% to 40% of energy to 15% to 20% of energy reduces total cholesterol and LDL-C levels by 10% to 20%.^{21–29} This response is likely attributable primarily to the decrease in saturated fat content of the diet rather than the increase in carbohydrate content.^{28,30} Short-term reductions in fat content from 25% to 15% of energy in the absence of weight loss have not been reported to decrease LDL-C levels further.²⁸

Blood Triglyceride Levels

TG levels consistently increase in response to short-term consumption of a very low fat diet.^{25,28,29,31–36} The magnitude of the response is highly variable among subjects and can represent a 70% increase from initial TG levels. Cross-country epidemiological comparisons support these observations.³⁷ Higher TG levels are frequently accompanied by lower HDL-C levels and higher total cholesterol/HDL-C ratios^{28,29,33,34,36,38,39} as well as increased levels of small, dense LDL particles.^{40,41} Very low fat diets increase TG levels regardless of whether the diet is high in simple or complex carbohydrates,^{30,42} but the increase may be attenuated by high dietary fiber intake⁴³ or weight loss.²⁹ Increased TG and decreased HDL-C levels due to increased carbohydrate intake are most likely in people with hypertriglyceridemia or hyperinsulinemia, especially those who are older, male, or inactive.³⁶ An additional concern is the atherogenic postprandial

lipemia associated with very low fat diets^{44–46} and the palmitate enrichment of circulating TG induced by increased fatty acid synthesis.⁴⁷ Weight loss attenuates the HDL-C–lowering effect of very low fat diets and is related in part to blunting the increase in TG levels.^{24,26,28,29} The long-term effect of very low fat diets on blood lipid levels after weight stabilization has yet to be determined.

Body Weight and Caloric Intake

The high caloric intake associated with high-fat diets is attributed to high palatability ratings and energy density.^{48–50} Well-designed studies have investigated the effect of covert manipulation of the fat content of foods on total energy consumption. Short-term consumption (14 days to 12 weeks) of reduced-fat diets decreases caloric intake and/or body weight.^{51,52} The weight of food consumed is frequently maintained or slightly increased when dietary fat content is drastically reduced.^{29,52,53} Investigators warn that subjects frequently adjust to the low-fat regimen over longer periods of time and increase energy intake, sometimes to prestudy levels.⁴⁹ Under less restrained conditions, individuals compensate for alterations in the macronutrient content of the diet.^{53,54} Unfortunately, the cost and restrictiveness of controlled long-term metabolic studies impedes research on this subject.

Few long-term intervention studies that have targeted fat intake to lower blood lipid levels and/or body weight have achieved levels $\leq 15\%$ of calories. Therefore, data from studies successful in dramatically reducing fat intake but achieving somewhat higher fat intakes are also considered. The Women's Health Trial^{55,56} reported reductions in dietary fat intake from 37% to 22% of energy, a change resulting in a 3-kg weight loss over a 2-year period. Sheppard et al⁵⁷ reported that intensive instruction to maintain a low-fat diet resulted in reduction of fat intake from 39% to 22% of calories and was accompanied by a 3.2-kg weight loss at 6 months, although this was reduced to 1.9 kg at the end of 2 years (the control group lost 0.1 kg at 2 years). Kasim et al²⁷ reported that as a result of dietary counseling, fat intake was reduced from 36% to 18% of energy, and body weight was reduced by 2.6 kg over a 1-year period (the control group lost 0.8 kg at 1 year). Thuesen et al²² provided dietary counseling to achieve a low-fat diet and followed up every 2 weeks for 3 months. Thuesen then asked the subjects to maintain the very low fat diet for an additional 9 months. Participants reduced total fat intake to 10% of calories after 3 months and experienced an 8.7-kg weight loss. After 12 months, fat intake was reported to be 15% of calories, but additional weight loss during the subsequent 9-month period was only 1.3 kg. The Lifestyle Heart Trial,¹⁹ which is an intensive program of dietary counseling, stress management, and moderate exercise, reduced subjects' fat intake from 32% to 7% of calories, which resulted in weight loss of 11 kg after the first year of intervention. At the 5-year follow-up, no further weight loss was noted, but participants indicated continued adherence to the program, including the very low fat diet.⁵⁸ Weight changes of ≈ 3 kg have been reported in other studies^{59–63} conducted over a 6-month to 1-year period in which fat reductions of $>10\%$ were achieved, but fat intakes

>15% of total calories still resulted. Therefore, at this point, there are few long-term data to suggest that very low fat diets alone will sustain long-term weight loss.

Nutrient Adequacy

The nutrient adequacy of very low fat diets is highly dependent on individual food choices. Very low fat diets can include nutrient-dense foods such as fruits, vegetables, whole grains, and low-fat or fat-free dairy products or more recent varieties of fat-free and low-fat alternatives to traditionally high-fat foods, such as snacks and desserts. The new fat-free and low-fat foods can be similar in caloric density to their full-fat counterparts. It has been suggested that confusion exists about appropriate serving sizes and frequency of consumption of some fat-modified foods.⁶⁴ It is interesting to note that in an effort to provide specific information, food labeling can have unintended consequences. For example, persons given yogurt labeled low fat consumed more energy at the next meal than persons given a yogurt of equal caloric content but labeled high fat. This result contrasts with consumption patterns observed in subjects not informed about the fat content of the diet.⁶⁵

Little is known about the magnitude of the impact of these newer fat-free and low-fat foods on the nutrient density of the diet, although it is obvious that the actual impact is highly variable and directly dependent on how frequently these foods are used and on the other food choices that make up the balance of the diet. Under controlled conditions, Dougherty et al⁶⁶ reported that reducing the fat content of the diet from 42% to 25% of calories by increasing carbohydrate intake derived from grains, fruits, and vegetables; trimming visible fat and/or skin from meat; consuming lower-fat dairy products; and carefully selecting vegetables, fruits, and grains on the basis of mineral content resulted in higher intakes of vitamins C, thiamine, riboflavin, niacin, B₆, B₁₂, and folate, and lower intakes of potassium, calcium, magnesium, phosphorus, iron, zinc, and copper. Retzlaff et al⁶⁷ reported that dietary counseling that produced a 10% decrease in calories from fat resulted in higher intakes of vitamin A, beta carotene, vitamin C, magnesium, iron, folate, vitamin B₆, thiamine, and riboflavin, and lower intakes of niacin, selenium, vitamin E, and zinc. Nutrient density is a complex topic and cannot be generalized; however, clearly specific food choices within the context of a very low fat diet are critical. Data on the impact of a relatively high proportion of low-fat and fat-free alternatives to traditional foods in a free-living population in the absence of intensive dietary counseling are not yet available.

Subgroups at Potential Risk for Nutrient Deficiency

Concern has also been raised about the long-term adequacy of very low fat diets in meeting essential fatty acid requirements,⁶⁸ particularly among very young children.⁶⁹ Very low fat diets are not advocated for this age group. The current recommendations are intended for persons >2 years old, and optimal fat intakes are not specified beyond <30% of daily caloric intake.⁷⁰ Recent evidence suggests no adverse effects of moderate fat restriction in young children, assuming caloric intake is adequate.⁷¹⁻⁷³ However, clearly, the strategy

used to decrease fat intake is critical in maintaining adequate nutrient intake.⁷⁴ Definitive data are lacking on the impact of very low fat diets in young children or other groups at potentially high risk, ie, pregnant women and the elderly, or after long-term adherence. The importance of the issue is not clear in the absence of established requirements for essential fatty acid intakes at any age. Estimated requirements range from 3% to 5% of caloric intake.^{75,76} This requirement translates to ≈7 to 11 g for a 2000-calorie diet and is usually met by the inclusion of polyunsaturated fats as a source of linolenic acid.

Additional unresolved questions on the use of very low fat diets include the feasibility of long-term restriction of certain foods, uncertainty about compromised absorption of fat-soluble vitamins, impact of increased dietary fiber on the absorption of other micronutrients, and potential risk for iatrogenic malnutrition. At this time, no health benefits and possible harmful effects can be predicted from adherence to very low fat diets in certain subgroups. In addition to young children, the elderly, pregnant women, and persons with eating disorders should not attempt a very low fat diet. Persons with insulin-dependent diabetes mellitus, elevated TG levels, and carbohydrate malabsorption illnesses should also avoid such a diet.

Conclusions

There is overwhelming evidence that reductions in saturated fat, dietary cholesterol, and weight offer the most effective dietary strategies for reducing total cholesterol, LDL-C levels, and cardiovascular risk. Decreases in saturated fat should come at the expense of total fat because there is no biological requirement for saturated fat. Essential fatty acids can be adequately derived from unsaturated sources even if total fat intake is <15% of calories, but the appropriate types and amounts of these dietary fat sources must be selected (ie, highly polyunsaturated vegetable oils).

Results from a few clinical trials suggest that very low fat diets are associated with reduced risk of cardiovascular disease, but numerous unanswered questions remain that make population-wide recommendations of such diets premature. Very low fat diets in the short term increase TG levels and decrease HDL-C levels without yielding additional decreases in LDL-C levels. The weight loss that may accompany such diets attenuates these adverse effects on plasma lipid levels. Because long-term results are not available to support the value of very low fat diets to either facilitate continued weight loss or further lower blood cholesterol levels, concerns about their widespread use remain. For certain persons, ie, those with hypertriglyceridemia or hyperinsulinemia, the elderly, or the very young, the potential for elevated TG levels, decreased HDL-C levels, or nutrient inadequacy must be considered.

Responses to any dietary intervention designed to alter blood lipid levels or body weight vary among individuals. Data are still lacking from randomized clinical trials in which representative population samples with adequate power were used to test whether there is substantial additional benefit to be derived from very low fat diets. Because very low fat diets represent a radical departure from the current prudent dietary

guidelines, such diets must be proved both advantageous and safe before national recommendations can be issued. In the interim, a limited group of motivated, high-risk persons with elevated LDL-C levels and/or preexisting cardiovascular disease may benefit from very low fat diets but only with support, careful supervision, and regular follow-up by the healthcare provider. Advice about optimal substitutions of complex carbohydrates for fat while preserving protein intake should be provided with ongoing assessment to ensure adequate long-term intake of micronutrients.

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