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DOES ALPHA-LINOLENIC ACID INTAKE REDUCE THE RISK OF CORONARY HEART DISEASE? A REVIEW OF THE EVIDENCE

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CONFLICTS OF INTEREST: None

STATEMENT OF PURPOSE

Alpha-linolenic acid (ALA) is an n-3 polyunsaturated fatty acid found mainly in plant sources, including flaxseed oil, canola oil, and walnuts. Although substantial evidence indicates that consumption of long-chain n-3 polyunsaturated fatty acids from seafood reduces the risk of coronary heart disease (CHD), the effect of ALA intake on CHD risk is less well-established. ALA may reduce cardiovascular risk through a variety of biologic mechanisms, including platelet function, inflammation, endothelial cell function, arterial compliance, and arrhythmia. Although clinical benefits have not been seen consistently in all studies, most prospective observational studies suggest that ALA intake reduces the incidence of CHD, and two randomized trials have demonstrated that a dietary pattern that includes fruits, vegetables, whole grains, nuts or legumes, and ALA-rich foods substantially reduces the recurrence of CHD events. Additional observational and clinical studies will help establish the effects of ALA on CHD risk and determine whether such effects vary based on gender, duration of intake, background dietary intake of seafood, or other factors. Presently, the weight of the evidence favors recommendations for modest dietary consumption of ALA (2 to 3 g per day) for the primary and secondary prevention of CHD.

OBJECTIVES

Upon completion of this article, participants should be able to:
1. Describe the major food sources of ALA.
2. Recognize potential mechanisms whereby ALA may reduce cardiovascular risk.
3. Review the results of major studies of ALA intake and CHD risk.

Alpha-linolenic acid (18:3, ALA) is an intermediate chain-length n-3 polyunsaturated fatty acid found mainly in plant sources. A substantial body of observational, clinical trial, and experimental evidence indicates that consumption of long-chain n-3 polyunsaturated fatty acids from seafood reduces coronary heart disease (CHD) risk, particularly risk of fatal CHD or arrhythmic death.[1-11] The effect of ALA intake on CHD risk, however, is less well-established. Worldwide, marine n-3 fatty acids are not as widely available as ALA because of the cost and supply constraints of seafood compared to plant sources. Whether ALA intake affects CHD risk is therefore of considerable public health importance, particularly for populations with low consumption or availability of fatty fish. This article

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reviews the current evidence from experimental animal studies, observational studies, and clinical trials for the effects of ALA consumption on CHD risk.

FOOD SOURCES AND METABOLISM

ALA cannot be synthesized by humans, and therefore, it is an essential fatty acid in the diet. In contrast to n-6 polyunsaturated fatty acids such as linoleic acid (18:2), which are widely found in a variety of vegetables and vegetable oils, relatively few foods contain significant amounts of ALA.[12] The major dietary sources of ALA are listed in Table 1. In the United States, the average intake of ALA is approximately 1 to 2 g per day, although intake varies greatly among individuals within the population.[13]

The distinction between n-6 and n-3 polyunsaturated fatty acids is based on the location of the first double (unsaturated) bond in the carbon chain. Counting from the methyl end, for n-6 fatty acids, the first double bond is located at the sixth carbon, whereas for n-3 fatty acids, the first double bond occurs at the third carbon. In humans and other mammals, the number of double bonds and carbons of a polyunsaturated fatty acid can be modified during metabolism by processes of desaturation or elongation (Figure 1), but the location of the first double bond cannot be altered; that is, once an n-3 fatty acid, always an n-3 fatty acid, and once an n-6 fatty acid, always an n-6 fatty acid. All n-3 fatty acids in human systems, therefore, must be either produced from the metabolism of ALA or directly consumed in the diet.

Several important, longer-chain n-3 fatty acids can be formed from ALA.[14] Metabolites include eicosapentaenoic acid (20:5, EPA) and docosahexaenoic acid (22:6, DHA), the long-chain n-3 fatty acids present in fatty fish and other seafood, and prostaglandin E3, an anti-inflammatory eicosanoid. Conversion of ALA to EPA occurs to some extent in humans, but further conversion to DHA is very low.[14] Conversion of ALA to longer-chain n-3 metabolites also may vary by gender, with conversion possibly being greater in women than in men.[14]

TABLE 1 Dietary Sources of Alpha-Linolenic Acid (ALA)

Food	ALA Content (g) per 100 g
Flaxseed (linseed) oil	53.3
Canola (rapeseed) oil	9.3
Walnuts	9.1
Butternuts	8.7
Soybean oil, non-hydrogenated	6.8
Mustard oil	5.9
Soybean oil, hydrogenated	2.6
Beechnuts	1.7
Pecans	1.0
Seaweed, Spirulina, dried	0.8
Soybeans, boiled	0.6
Navy beans, boiled	0.3
Kidney beans, boiled	0.2
Kale, raw	0.2

Data from the US Department of Agriculture National Nutrient Database for Standard Reference, 2004.[12]

THE N-6:N-3 RATIO

Compared to more traditional diets, dietary patterns in industrialized nations have shifted during the last two centuries toward higher amounts of n-6 fatty acids and lower amounts of n-3 fatty acids.[15] In ecological (ie, cross-population) studies, these nutritional shifts have been associated with parallel increases in CHD incidence.[13,15] Experimental studies suggest that n-6 fatty acids may compete with n-3 fatty acids for their common metabolic enzymes, so that a higher relative intake of n-6 to n-3 fatty acids might increase production of pro-thrombotic and pro-inflammatory n-6 metabolites, compared with anti-thrombotic, anti-inflammatory, and anti-arrhythmic n-3 metabolites (Figure 1).[15-18] During their incorporation (esterification) into plasma phospholipids and triglycerides, n-6 and n-3 fatty acids may also compete.[19] These ecologic and experimental data have raised concerns that n-6 fatty acids may counteract potential cardiovascular benefits of n-3 fatty acids, resulting in recommendations to decrease the relative intake of n-6 to n-3 fatty acids (the n-6:n-3 ratio).[13,15] This potential competition between n-6 and n-3 fatty acids may be most relevant for ALA, which requires desaturation

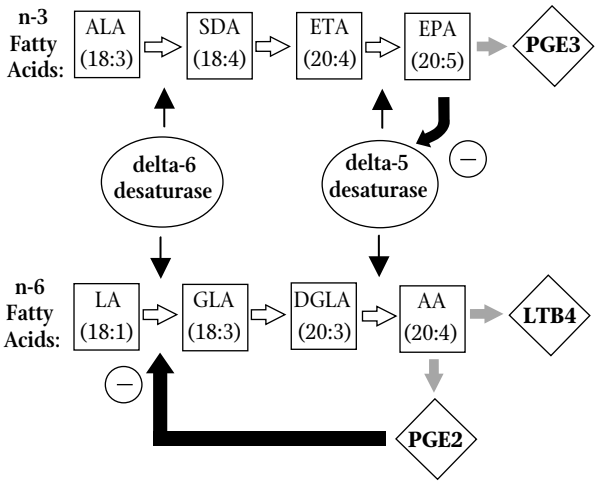

FIGURE 1 Metabolism of n-6 and n-3 Polyunsaturated Fatty Acids*

Note: n-3 and n-6 fatty acids are each metabolized by the same delta-5 and delta-6 desaturase enzymes, necessary for conversion of alpha-linolenic acid (ALA) to eicosapentaenoic acid (EPA), and linoleic acid (LA) to arachidonic acid (AA). EPA is converted to prostaglandin E3 (PGE3), an eicosanoid with anti-inflammatory and anti-thrombotic effects, and AA is converted to prostaglandin E2 (PGE2) and leukotriene B4 (LTB4), both pro-inflammatory eicosanoids. The metabolites in these pathways also exert feedback inhibition (black arrows); for example, PGE2 inhibits the delta-6 desaturase, and EPA inhibits the delta-5 desaturase. SDA=stearidonic acid (octadecatetranoic acid). ETA=eicosatetraenoic acid; GLA=gamma linolenic acid; DGLA=dihomogamma linolenic acid.[7]

*Adapted with permission from Mozaffarian D, Ascherio A, Hu FB, et al. Interplay between intermediate-chain n-3, long-chain n-3, and n-6 polyunsaturated fatty acids and risk of coronary heart disease in men. *Circulation.* 2005;111:157-164.

and elongation to form longer-chain metabolites, compared with EPA or DHA, which do not require these enzymes for metabolism. However, such concerns have not been substantiated in cohort studies evaluating CHD risk in humans (see Observational Studies, below), and, thus, the relevance of the concept of the n-6:n-3 ratio to CHD risk is unclear.

EXPERIMENTAL STUDIES

Several physiologic effects of n-3 fatty acids may reduce cardiovascular risk (Table 2). In experimental studies, n-3 fatty acids favorably influence vascular tone, heart rate, autonomic tone, serum lipid levels, platelet function, inflammatory responses, endothelial cell function, insulin sensitivity, left ventricular diastolic function, and arrhythmia.[10,11,15,17-29] While most experimental studies have focused on long-chain n-3 fatty acids (ie, EPA and DHA), several of these effects appear to be similar for ALA. For example, in a trial among 20 healthy men, six weeks of a high canola oil diet (2.3% energy from ALA) reduced *in vitro* platelet aggregation, compared to a high sunflower oil diet (0.3% energy from ALA).[22] Among 10 healthy subjects, postprandial endothelial cell function was preserved following meals (214.29 kJ [900 kcal], 50 g fat) containing canola oil or salmon, compared with olive oil.[27] In 76 men with dyslipidemia, a high ALA diet (canola oil 15 mL per day) for three months resulted in reductions in systemic inflammation as measured by C-reactive protein, serum amyloid A, and interleukin-6, compared with a control (safflower oil) diet.[28] Among 15 adults with obesity and insulin resistance, four weeks of a flaxseed oil margarine diet (20 g per day ALA) improved systemic arterial compliance, compared with control (ie, oleic acid).[24] In rats, the incidence of ischemia-reperfusion-induced ventricular fibrillation was reduced after 12 weeks of a canola oil-enriched diet, compared to an olive oil-enriched diet.[23]

Thus, trials evaluating secondary outcomes in humans and experimental animal studies indicate that, similar to long-chain fatty acids in fish, ALA has several effects, which might reduce cardiovascular risk. It is unclear to what extent these experimentally observed effects of ALA may be related to a direct physiologic effect versus conversion to more active long-chain metabolites such as EPA; nevertheless, in either case, a diet enriched with ALA appears to favorably affect cardiovascular risk factors.

TABLE 2 Physiologic Effects of n-3 Fatty Acids that May Reduce Cardiovascular Risk*

Decreased heart rate
Reduced systemic vascular resistance
Increased arterial compliance
Improved autonomic tone
Attenuated responses to arterial vasoconstrictors
Improved left ventricular diastolic function
Increased threshold for cardiac arrhythmias
Improved endothelial cell function
Decreased systemic inflammation
Reduction in serum triglycerides
Inhibition of platelet aggregation and thrombosis
Altered adipocyte insulin sensitivity

*From experimental studies in humans and animal models (see text).

OBSERVATIONAL STUDIES

Several observational studies have evaluated the relationship between ALA intake and risk of CHD or mortality (Table 3). In a cross-sectional analysis, higher ALA consumption was associated with a lower prevalence of CHD,[30] but these findings were potentially limited by the cross-sectional design (having the disease may have altered the diet, rather than vice versa) and survival bias (people who had died from CHD could not be included). Levels of ALA in adipose tissue (a biomarker of dietary intake) were inversely associated with CHD risk in one retrospective case-control study,[31] but not in two other studies.[32,33] Retrospective case-control studies may be limited by selection bias (eg, controls may not represent the population from which the cases arose) and survival bias (eg, fatal CHD events cannot be included as cases).

The relationship between ALA consumption and CHD risk also has been evaluated in several prospective cohort studies, which minimize the above limitations. Two northern European studies did not observe a significant relationship between ALA intake and CHD incidence;[34,35] the absence of significant benefit might have been related in part to confounding by associated trans fatty acid intake,[34,35] which would increase CHD risk.[36] Among middle-aged US women, greater ALA intake was associated with lower total mortality, with 15% lower risk in the highest tertile of intake, compared with the lowest (P=.01).[37] Four other prospective studies in the US have observed an inverse association between ALA consumption and the incidence of CHD. Among 45,722 male health professionals, ALA intake was inversely associated with CHD incidence, with 16% lower risk (95% confidence interval [CI]=0-29%) for each one g per day higher intake.[7] Among 6,250 men enrolled in the usual care arm of the Multiple Risk Factor Intervention Trial, ALA intake was associated with lower 10-year rates of CHD mortality (P<.04), total cardiovascular disease (P<.03), and all-cause mortality (P<.02), with 40% lower risk of CHD mortality, comparing the highest to the lowest quintile of ALA intake.[38] Among 76,283 female nurses, ALA intake was associated with lower risk of fatal CHD (P=.01), with 45% lower risk (95% CI=6% to68%) in the highest quintile of intake (median 1.36 g per day), compared with the lowest quintile (median 0.71 g per day).[39] In a nested, case control study among 5,888 older adults, each one standard deviation increase in plasma phospholipid ALA levels (a biomarker of dietary intake) was associated with 52% lower risk (95% CI=4% to 76%) of fatal CHD.[4] Thus, most observational studies—and particularly those in US populations—suggest that dietary consumption of ALA reduces the incidence of CHD.

As described previously, ecologic and experimental studies have suggested that consumption of n-6 fatty acids may counteract beneficial effects of ALA on cardiovascular risk. Evidence

TABLE 3 Observational Studies of ALA Consumption and CHD Risk

Study, Publication Year	Design	Participants	Assessment of ALA	Outcome	No. of Events	Risk Reduction with Higher ALA (95% CI or *P* value)
Family Heart Study,[30] 2001	Cross-sectional cohort	4,584 men and women	Dietary intake	Prevalent total CHD	485	Men: ↓ 40% (8-61%) Women: ↓ 58% (16-78%) (comparing extreme quintiles)
Costa Rica,[31] 2003	Retrospective case-control	964 men and women	Adipose tissue levels	Nonfatal MI	482	↓77% (50-90%) (comparing extreme quintiles)
Olso,[33] 2000	Retrospective case-control	198 men and women	Adipose tissue levels	Nonfatal MI	100	No significant association
EURAMIC,[38] 1999	Retrospective case-control	1,339 men	Adipose tissue levels	Nonfatal MI	639	No significant association
Finland ATBC,[34] 1997	Prospective cohort	21,930 male smokers	Dietary intake	Major CHD events	1,399	No significant association
Zutphen Elderly Study,[35] 2001	Prospective cohort	677 older men	Dietary intake	Major CHD events	98	No significant association
Iowa Women's Health Study,[37] 2004	Prospective cohort	41,836 women*	Dietary intake	Total mortality	922	↓ 15% (*P* trend 0.01) (comparing extreme tertiles)
Health Professionals Study,[7] 2005	Prospective cohort	45,722 men	Dietary intake	Major CHD events	2,306	Overall: ↓ 16% (0-29%) Low seafood eaters: ↓47% (17-66%) (each 1 g/d)
MRFIT usual care,[38] 1992	Prospective cohort	6,250 men	Dietary intake	CHD mortality	289	↓ 40% (*P*<.04) (comparing extreme quintiles)
Nurses Health Study,[39] 1999	Prospective cohort	76,283 women	Dietary intake	CHD mortality	597	↓ 45% (6-68%) (comparing extreme quintiles)
Cardiovascular Health Study,[4] 2003	Prospective cohort (nested)	5,888 older men and women†	Plasma phospholipid levels	Major CHD events	179	↓ 52% (4-76%) (each 1 SD)

*Total number of participants; results were reported only for women free of heart disease at baseline (number not reported).
† Total number of participants; a nested case-control design was used.
ALA=alpha-linolenic acid. ATBC=Alpha-tocopherol, beta-carotene prevention study. CHD=coronary heart disease. EURAMIC=European multicenter case-control study on antioxidants, myocardial infarction, and breast cancer. MI=myocardial infarction. MRFIT=Multiple risk factor intervention trial.

from observational cohort studies does not support this hypothesis, however. In the Family Heart Study, n-6 fatty acid intake did not appreciably modify the inverse association between ALA intake and prevalence of CHD.[30] In two large, prospective, cohort studies among US women and men, intake of n-6 fatty acids did not significantly alter the inverse association between ALA and incidence of CHD.[7,39] Although further study of this question is warranted, these studies suggest that n-6 intake within the normal dietary range in humans does not appreciably attenuate the benefits of ALA consumption on cardiovascular risk.

Interestingly, in one study among US men, the strongest relationship between ALA intake and CHD risk was seen among participants who consumed very little seafood (Figure 2).[7] Among men with little to no seafood intake (EPA+DHA intake <100 mg per day), each 1 g per day ALA intake was associated with ~50% lower risk of both nonfatal myocardial infarction (MI) and total CHD. The risk estimate was similar for sudden death, but fewer numbers of events limited the ability to confirm this association. In contrast, among men with some seafood intake (EPA+DHA intake ≥100 mg/d), ALA intake was not significantly associated with CHD risk (Figure 2). Long-chain n-3 fatty acids may inhibit ALA metabolism via feedback inhibition (Figure 1),

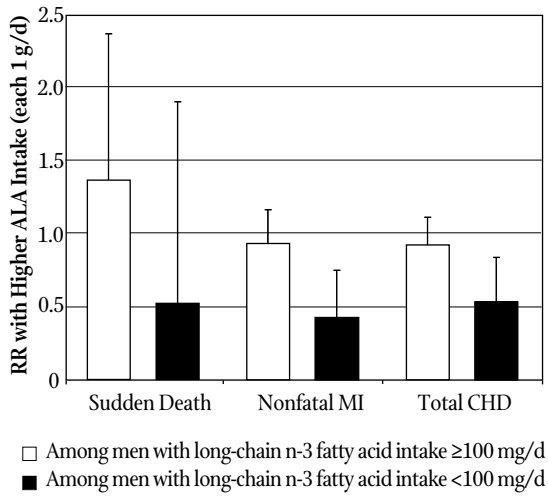

FIGURE 2 Relative Risks of CHD Associated with Each 1 g per Day of Higher ALA Intake

Results are shown separately for 38,367 men with some seafood intake (long-chain n-3 fatty acid intake ≥100 mg/d; white columns) and 7,355 men with little or no seafood intake (long-chain n-3 fatty acid intake <100 mg/d; black columns). For both nonfatal MI (*P* interaction=.003) and total CHD (*P* interaction=.006), the effects of ALA intake on CHD risk were greater among men with little or no seafood intake. Error bars indicate the upper limit of the 95% CI. Relative risks are multivariate-adjusted for other risk factors.[7]

* Adapated with permission from Mozaffarian D, Ascherio A, Hu FB, et al. Interplay between intermediate-chain n-3, long-chain n-3, and n-6 polyunsaturated fatty acids and risk of coronary heart disease in men. *Circulation*. 2005;111:157-164.

suggesting a potential biologic mechanism for this observation. If benefits of ALA are greatest when EPA+DHA intake is very low, then consumption of plant sources of n-3 fatty acids may be particularly important for CHD prevention among individuals who do not regularly consume fatty fish or in areas in which fatty fish is not readily available. Further investigation of this relationship and potential underlying mechanisms is necessary.

CLINICAL TRIALS

Randomized clinical trials have evaluated the effect of an ALA-rich diet on CHD risk, including two trials among individuals without known CHD (ie, primary prevention) and three trials among patients with established CHD (ie, secondary prevention) (Table 4). In the earliest study, 13,406 Norwegian men without known CHD were randomized to flaxseed oil (5.5 g of ALA per day) versus sunflower oil.[40] There was no significant difference between the two groups in all-cause mortality or CHD mortality, but findings may have been limited by the brief duration of follow-up (one year). In the Finnish Mental Hospital Study, dairy fats were replaced with vegetable oils, primarily soybean oil, in one hospital, and in the other hospital the usual diet was continued for a period of six years (1959 to 1965).[41,42] The hospital diets were then switched, and patients were followed for another six years (1965 to 1971). A total of 676 men and 591 women without known CHD were enrolled in one or both periods, with subjects leaving the hospitals being "replaced" with new subjects throughout the trial. Compared to the control diet, the intervention diet contained less saturated fat and more polyunsaturated fat and was particularly rich in ALA—adipose tissue levels of ALA increased three-fold in men and five-fold in women. When the event rates in each period for the two hospitals were averaged, the intervention diet reduced the incidence of major electrocardiographic change or CHD death by 67% in men (*P*=.001) and 60% in women (*P*=.10). This study had an unusual design with important limitations—including the cross-over design, open enrollment, lack of blinding, and lack of individual randomization. Nevertheless, the results are informative and suggest that a diet rich in plant fatty acids, including ALA, might reduce the risk of a first CHD event.

Three other trials have investigated the effect of an ALA-rich diet on the prevention of recurrent CHD events. One trial randomized patients with acute MI to mustard oil (2.9 g per day of ALA) versus placebo.[43] Compared to placebo, the ALA group had a trend toward fewer CHD events, but this reduction was not statistically significant (relative risk=0.81, 95% CI=0.30 to 1.12), possibly limited by the relatively small number of subjects (N=238) and brief duration of follow-up (one year). Interestingly, in this study, ALA supplementation reduced the incidence of angina, arrhythmias, and poor left ventricular function by approximately 50% each (*P*<.05 for each), but there were not prespecified primary outcomes.

In India, 1,000 patients with established CHD or CHD risk factors were randomized to control dietary advice (ie, the National Cholesterol Education Program [NCEP] step I diet: <30% total fat, <10% saturated fat, <300 mg cholesterol) versus the NCEP step I dietary advice plus advice to consume a diet rich in fruits, vegetables, whole grains, walnuts or almonds, and mustard oil or soybean oil (rich in ALA) at least 3 to 4 servings per day.[44] At two years, compared with controls, the intervention group consumed one-third less saturated fat and twice the amounts of ALA, whole grains, and dietary fiber. Weight, blood pressure, and low-density lipoprotein (LDL) cholesterol improved in both groups, though more so in the intervention group. High-density lipoprotein (HDL) cholesterol increased by 3% in the intervention group and decreased by 3% in the control group. Compared with controls, the intervention dietary advice reduced cardiac events by 52% (95% CI=29% to 67%), with 33% lower risk of fatal MI, 53% lower risk of nonfatal MI, and 67% lower risk of sudden death (*P*<.05 for each).

In France, 605 patients with a recent MI were randomized to usual care versus advice to consume more bread, fruits, vegetables, legumes, fish, and red wine; to use canola or olive oils for salads and food preparation; and to replace beef and pork with poultry.[45,46] Additionally, the intervention group was supplied with canola margarine, rich in ALA. At a mean follow-up of 27 months, compared with controls, the intervention group consumed approximately 10% less total energy, 33% less saturated

TABLE 4 Randomized Trials of ALA Consumption and CHD Risk

Study, Publication Year	Subjects	Intervention	Outcome	Duration of Follow-up	No. of Events	Risk Reduction with Intervention (95% CI or *P* value)
Norwegian,[40] 1968	13,406 men	Flaxseed oil (5.5 g/d ALA)	Total and CHD mortality	1 year	485	No significant effect
Finnish Mental Hospital Study,[41-42] 1979, 1983	1,267 men and women*	Soybean oil (5.6 g/d ALA)	ECG change or CHD death	12 years†	45	Men: ↓ 67% (*P*=0.001) Women: ↓ 60% (*P*=0.10)
Indian Experiment of Infarct Survival-4,[43] 1997	238 men and women with recent MI	Mustard oil (2.9 g/d ALA)	CHD death or nonfatal MI	1 year	75	No significant effect‡
Indo-Mediterranean Diet Heart Study,[44] 2002	1,000 men and women with CHD or CHD risk factors	Mustard oil or soybean oil, nuts, fruits, vegetables, whole grains (1.8 g/d ALA)	CHD death or nonfatal MI	2 years	115	↓52% (29% to 67%)
Lyon Diet Heart Study,[45] 1994	605 men and women with recent MI	Canola margarine, fruits, vegetables, legumes, bread, fish, red wine, canola or olive oil, poultry (1.8 g/d ALA)	CHD death or nonfatal MI	27 months	41	↓73% (41% to 88%)

*Not all participants were enrolled throughout the trial, and subjects leaving the trial were replaced with new subjects.
†Participants were treated with the intervention or control diet for 6 years and then crossed over to the other diet.
‡ALA supplementation reduced the incidence of angina, arrhythmias, and poor left ventricular function by ~50% each (*P*<.05 for each), but these were not prespecified primary outcomes.
ALA=alpha-linolenic acid. CHD=coronary heart disease. ECG=electrocardiographic. MI=myocardial infarction.

fat, 25% more monounsaturated fat and fruits, twice the amount of legumes, and three times more ALA. Compared to controls, the intervention dietary advice reduced cardiovascular events by 73% (95% CI=41% to 88%) and overall mortality by 70% (95% CI=18% to 89%).

In these two secondary prevention trials, therefore, a diet rich in ALA markedly reduced recurrent coronary events. However, the ALA intake was only one component of a dietary program that also included advice to increase intake of whole grains, fruits and vegetables, nuts or legumes, and, in the latter study, monounsaturated oils, fish, and red wine. Therefore, although these studies do not conclusively establish that ALA intake per se reduces risk, the findings clearly indicate that a healthy dietary pattern that includes foods rich in ALA substantially decreases the risk of CHD.

OTHER OUTCOMES

ALA may have effects on other disease outcomes as well. For example, several observational studies have demonstrated a positive association between ALA consumption and the incidence of prostate cancer in men. However, this relationship has not been seen in all studies.[47,48] If confirmed in future studies, such a higher risk should be balanced against potential benefits on risk of CHD, which occurs earlier in life and carries a much higher mortality rate. ALA intake also may reduce the risk of stroke, though few studies have evaluated this relationship.[49]

CONCLUSIONS

Evidence from experimental, observational, and clinical studies suggests that consumption of ALA, found in flaxseed oil, canola oil, walnuts, and other plant sources, reduces CHD risk. ALA may reduce cardiovascular risk via a variety of biologic mechanisms, including effects on platelet function, inflammation, endothelial cell function, arterial compliance, and arrhythmia. Although clinical benefits have not been seen consistently in all studies, most prospective observational studies suggest that ALA intake reduces the incidence of CHD, and two randomized trials have demonstrated that a dietary pattern that includes fruits, vegetables, whole grains, nuts or legumes, and foods rich in ALA substantially reduces the recurrence of CHD events. Additional observational and clinical studies will further establish the effects of ALA on CHD risk and determine whether such effects vary based on gender, duration of intake, background dietary intake of seafood, or other factors. At the present time, the weight of the evidence favors recommendations for modest dietary consumption of ALA (2 to 3 g per day) for the primary and secondary prevention of CHD.

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