Good Fat, Bad Fat & Your Heart
Part 3: Effects of Dietary Fat Types on Heart Health

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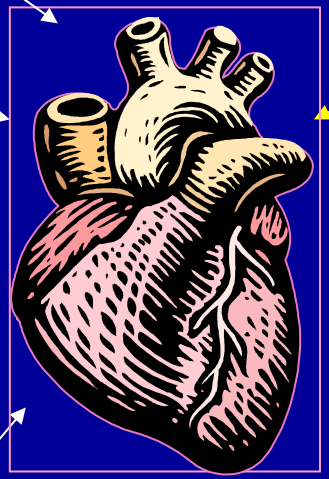
Risk Factors of Cardiovascular Disease CVD

Established Risk Factors

- Age, Gender, Family history of CVD
- Diabetes
- Hypertension
- Obesity
- High TC&LDL-C, TG Low HDL-C



Emerging Risk Factors

- Inflammatory markers (CRP, IL-6 and adhesion molecules, E-selectin) (Protein molecules formed during injury, deposit in coronary artery
- High Homocysteine
- High ApoB
- Lipid oxidation
- High Lp(a)
- Platelet aggregation/ Clotting factors

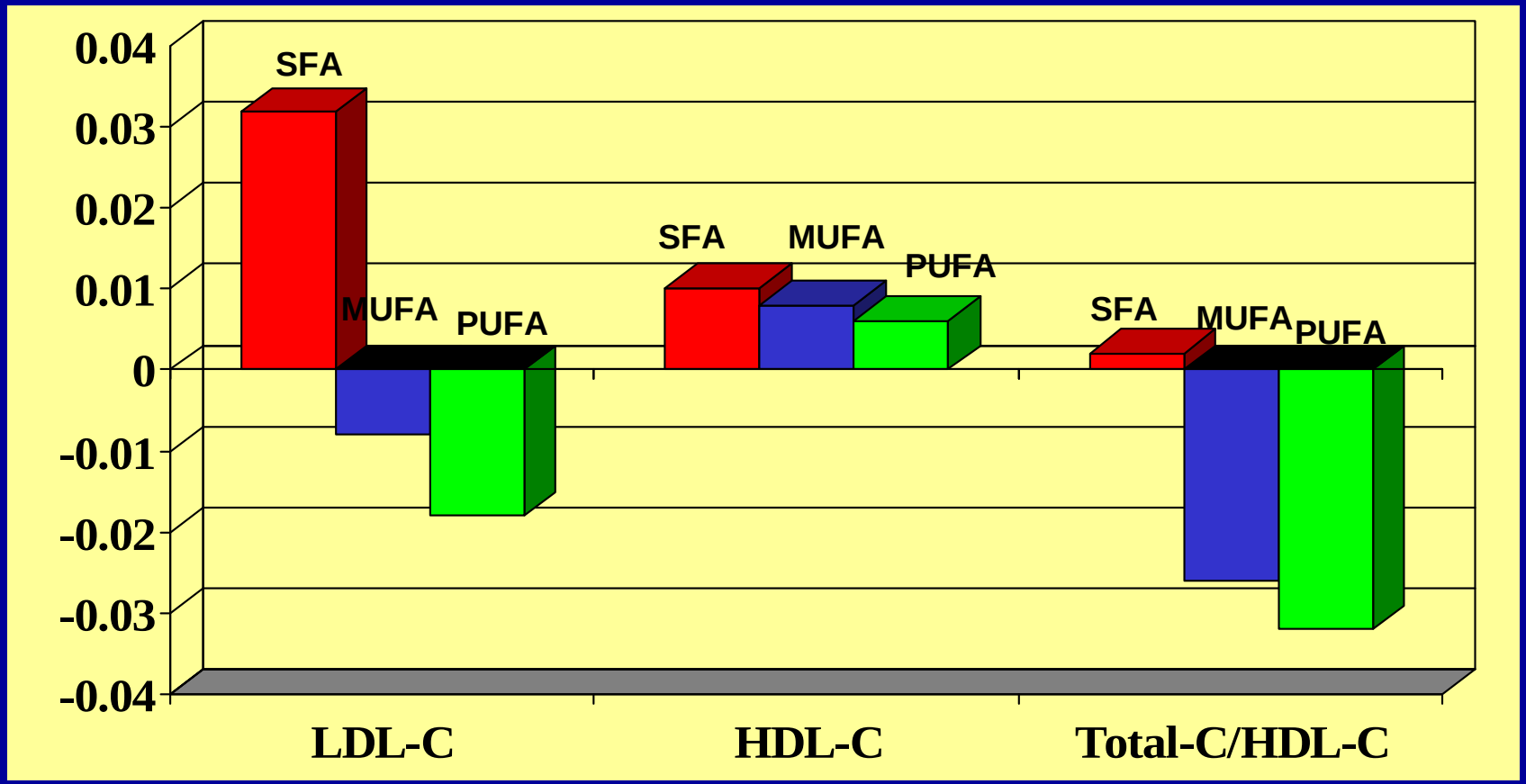
Source: Mustad, V. Current Atheroscler Reports, 2000, 2:461-66.

Blood Lipid Risk Factors

- High level of LDL-cholesterol and low level of HDL-cholesterol constitute major risk factors for heart disease.
- AHA recommendation:
  LDL-C <130 mg/dL (3.4 mmol/L),
  HDL-C >40 mg/dL (1.0 mmol/L)

Ratio of total-cholesterol (or LDL-C) to HDL-C represents two potent risk factors; an elevated total cholesterol and a low HDL-cholesterol. Ratio <4.6

Predicted changes in blood cholesterol when 1% of energy of dietary carbohydrates are replaced by saturated (SFA), monounsaturated (MUFA) and polyunsaturated (PUFA) fatty acids



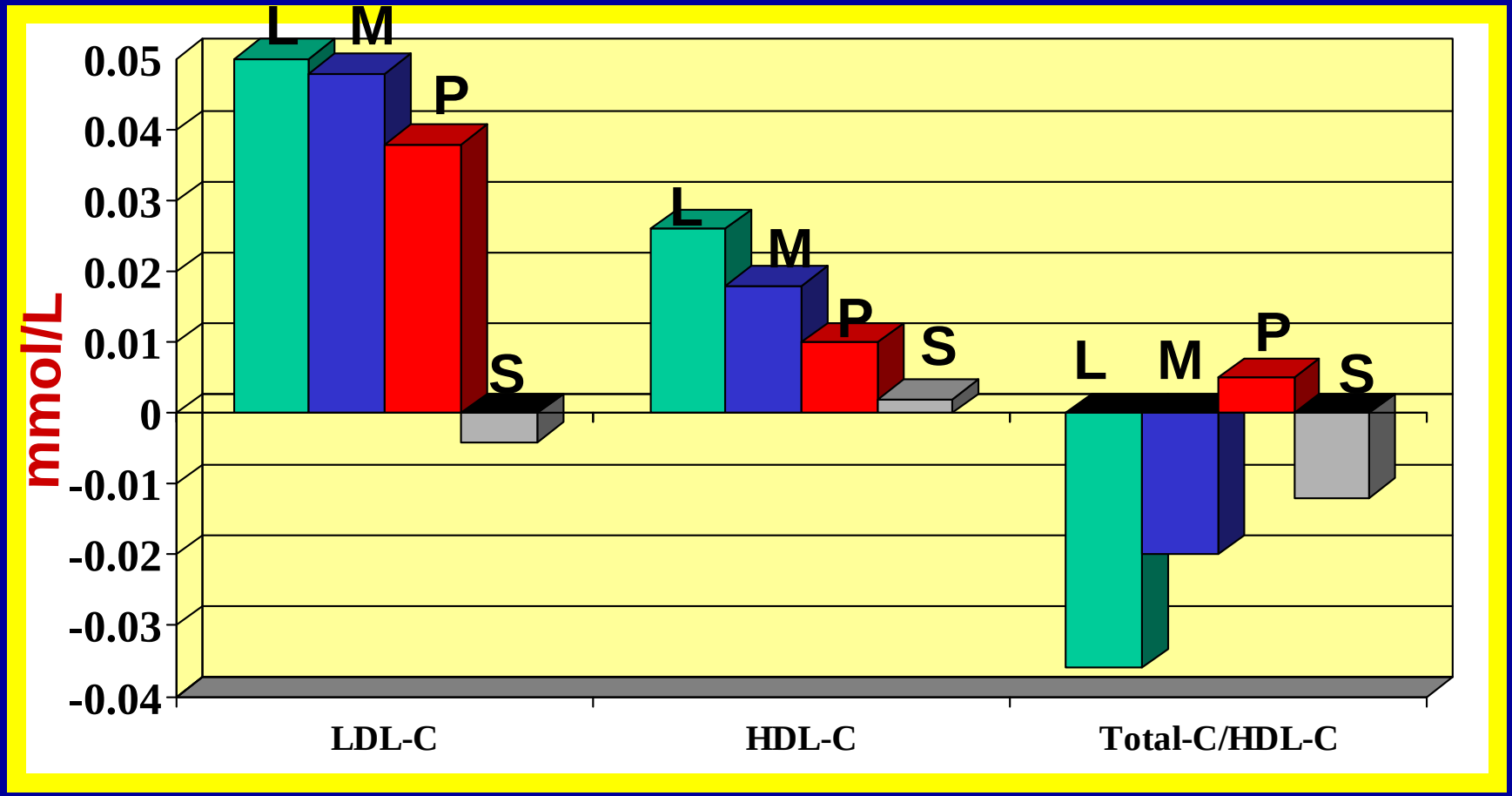
Meta analysis of 60 clinical trials (up to 2002)

Mensink, Katan, Zock J Clin Nutr 77:1146 (2003)

Major types of dietary fat and risk of coronary heart disease: a pooled analysis of 11 cohort studies (Jacobsen et al. AJCN 2009:89;1425-32)

- Pooled data of 344,696 subjects. During 4-10 y follow-up, 5249 coronary events and 2155 coronary deaths occurred.
- Direct association between SFAs and CHD
- Direct association between carbs and CHD
- No association between MUFAs and CHD
- Inverse association between PUFAs and CHD
- Replacing 5% energy (10g) from SFAs with equal amount of energy from PUFAs reduces the risk of coronary events by 69% and deaths due to CHD by 57%.

Predicted changes in blood cholesterol when 1% of dietary carbohydrates are replaced by lauric (L), myristic (M), palmitic (P) or stearic (S) acids



Mensink et al AJCN 2003

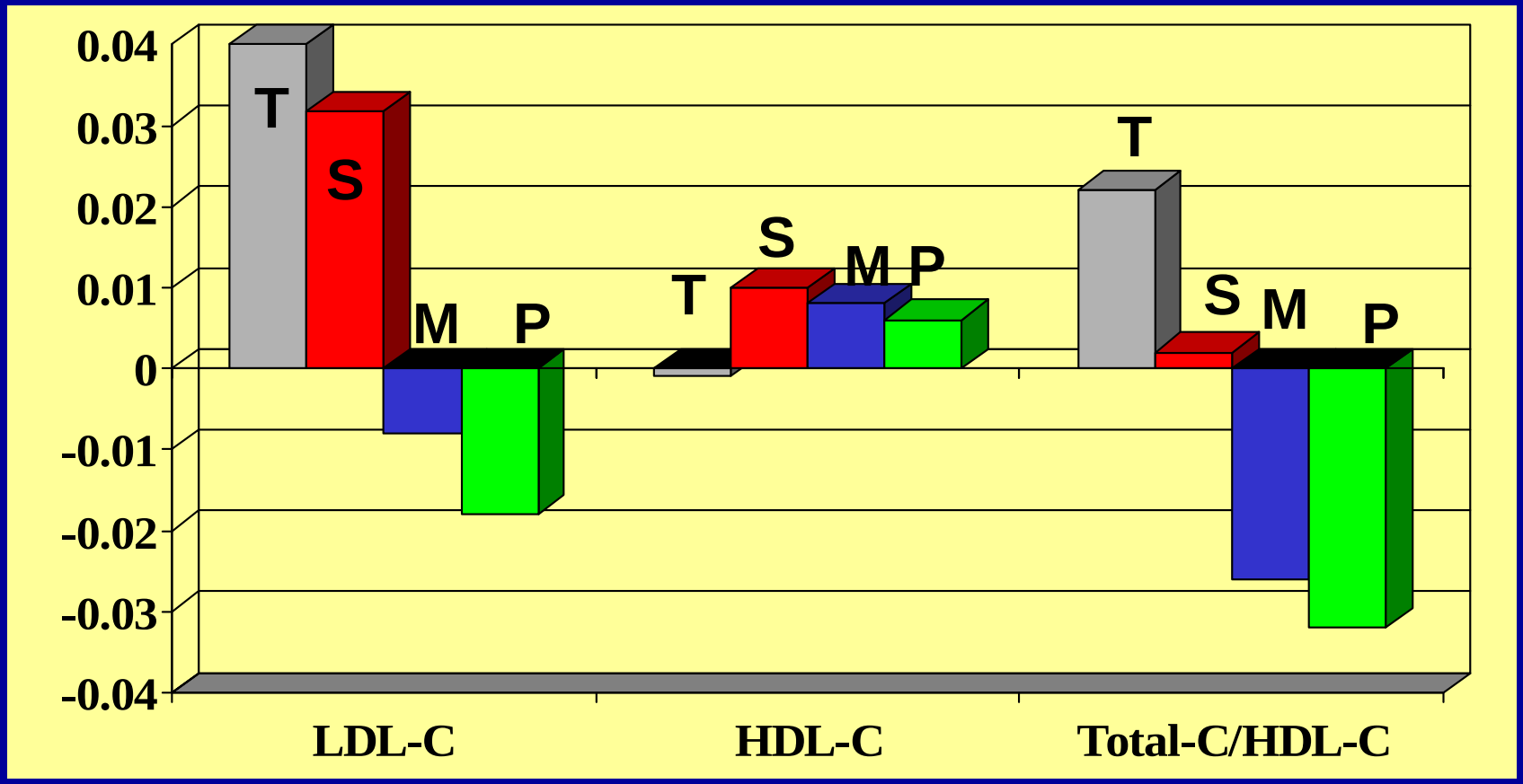
Saturated fatty acid composition (% total fatty acids) of common dietary fats

Fat	Lauric 12:0	Myristic 14:0	Palmitic 16:0	Stearic 18:0
Coconut	48.5	17.6	8.4	2.5
Palm	0.3	1.1	45.1	4.7
Canola	0	0	3.9	1.9
Soy	0	0.1	11.0	4.0
Corn	0	0	12.0	2.2
Sunflower	0.5	0.2	6.8	4.7
Olive	0	0	13.7	4.7
Butter	3.1	11.7	26.2	12.5
Pork (lard)	0.1	1.5	24.8	12.3
Beef (tallow)	0.1	3.3	25.5	21.6
Chicken	0.2	1.3	23.2	6.4

Trans fatty acids

- Present naturally in small amounts in dairy products and meat from ruminant animals (0.1 to 0.2 g/100 g)
- Trans fats are also produced when manufacturers use a process called partial hydrogenation to convert liquid oils to solid fats (10 to 50% trans fat).
- Trans fats are used in the manufacture of margarines, shortening and commercial preparation of bakery products and deep fried foods.

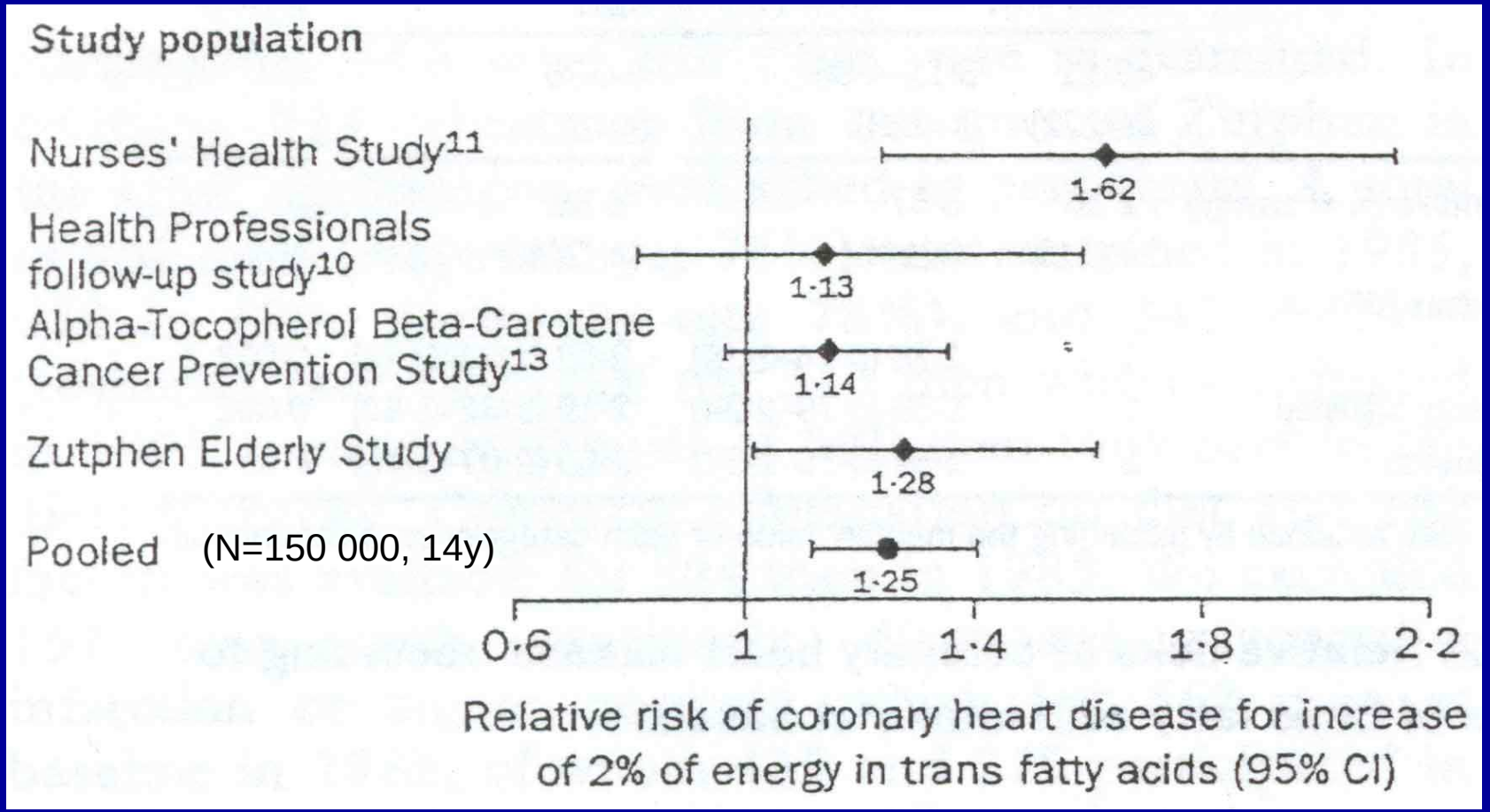
Predicted changes in blood cholesterol when 1% of energy of dietary carbohydrates are replaced by trans (T), saturated (S), monounsaturated (M) or polyunsaturated (P) fatty acids



Meta analysis of 60 clinical trials (up to 2002)

Mensink et al. Am J Clin Nutr 77:1146 (2003)

Relationship between TFA intakes and risk of CHD



An increase of TFA by 2% energy (4g) increases the risk of CHD by 125%. Whereas, 5% energy(10g SFA) is required to increase the risk to the same extent.

Oomen et al., Lancet 2001;Vol. 357: 746-751

Dietary Recommendations for saturated and trans fats

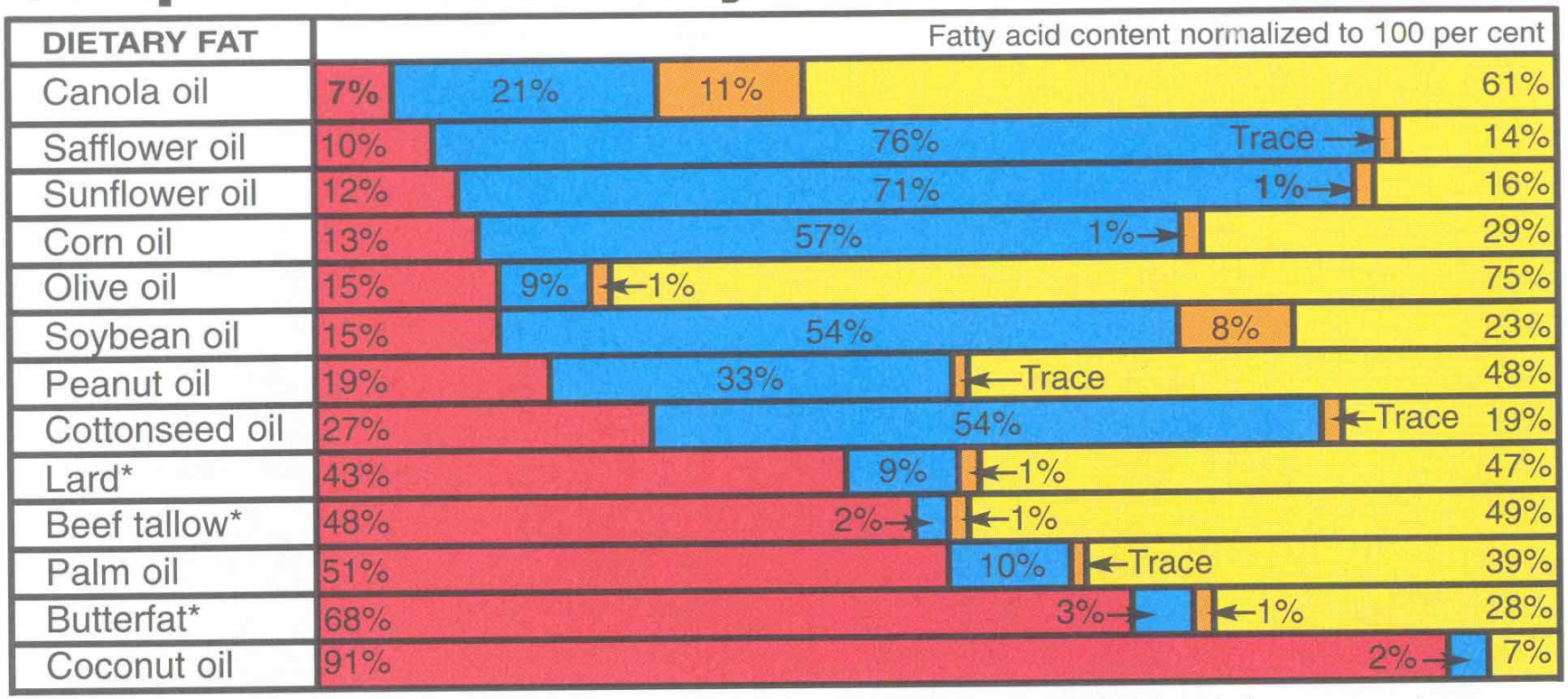
Organization	Saturated fat (% energy)	Trans Fat (% energy)
American Heart Association (2006)	<10% (population) <7% (at risk of CHD)	<1%
US Institute of Medicine (2003)	Low as possible	Low as possible
WHO/FAO (2009)	<10% (population)	<1%
Health Canada (2003)	<10%	<1%
The Netherlands	<10%	<1%

10% energy= 24 g of fat per 2000 Calorie diet
(2.5 table spoons of fat)

FAO/WHO (2009) Recommendations for PUFA Intakes

Fatty acid	Prevention of EFA Deficiency	Prevention of CHD (Heart Healthy Diet)
PUFA (sum of n-6 & n-3)	3 % energy (6.6 g/d)	6% energy (13.2 g/d)

Comparison of Dietary Fats



** Cholesterol Content (mg/Tbsp): Lard 12; Beef tallow 14; Butterfat 33. No cholesterol in any vegetable-based oil.*
Source: POS Pilot Plant Corporation, Saskatoon, Saskatchewan, Canada June 1994

SATURATED FAT

MONOUNSATURATED FAT

POLYUNSATURATED FAT

Linoleic Acid

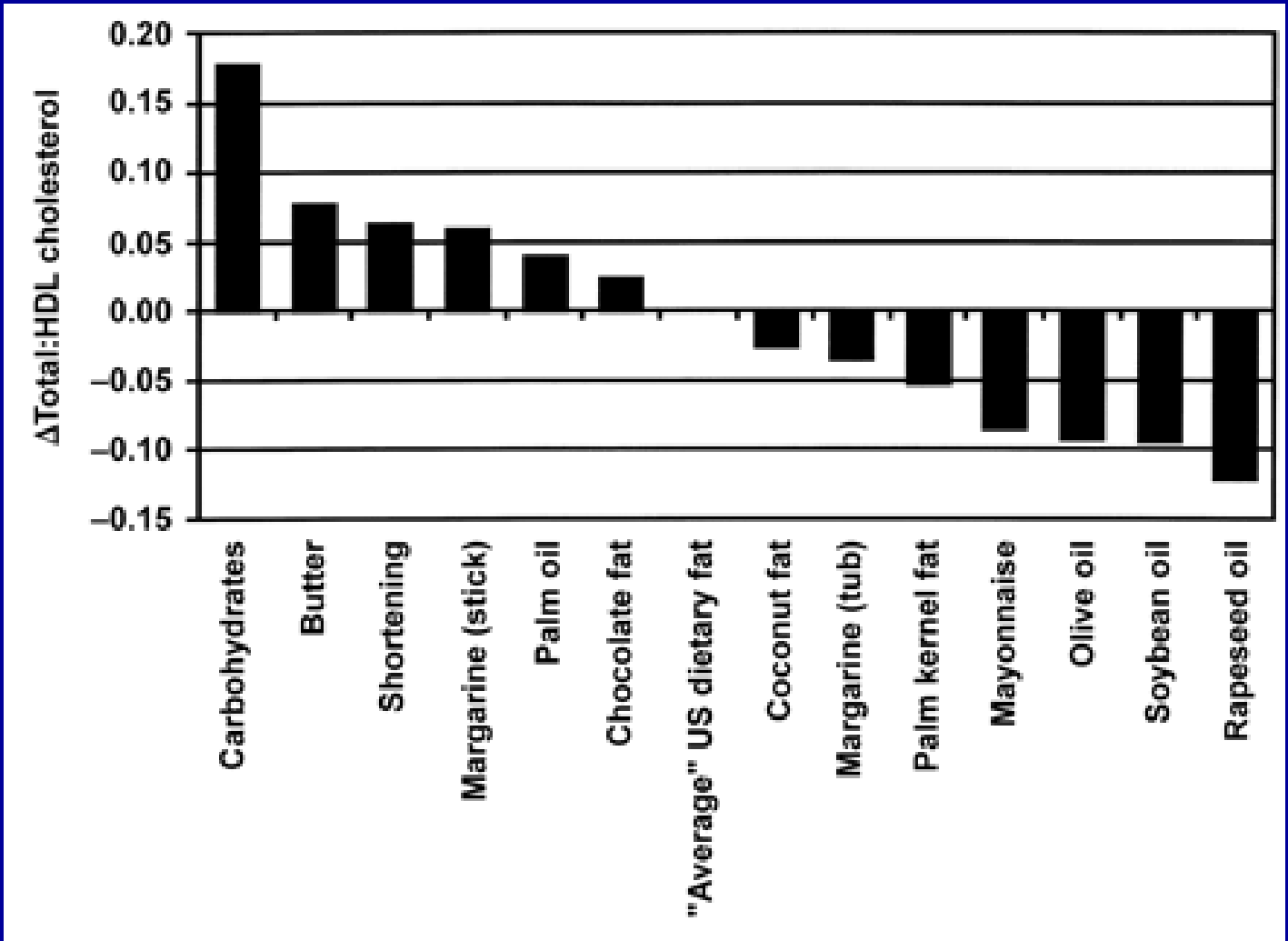
Alpha-Linolenic Acid (An Omega-3 Fatty Acid)

CANOLA COUNCIL OF CANADA 400-167 LOMBARD AVENUE WINNIPEG MANITOBA CANADA R3B 0T6

Average saturated, trans and polyunsaturated fatty acid Intakes (% total energy) and CVD death rates

Country	SFA	TFA	PUFA	Deaths due to CVD per year per 100 000 population (2006 data)
Australia (1995)	12.5-12.6%	NA	4.6%	308
Canada (2008) (Ratnayake et al. J.AOAC Int.)	10.4%	1.4%	5.6%	220
Sri Lanka (2001) (Mendis et al. BJN)	25% (58g) (71% from CNO)	NA	1-2%	680
FAO/WHO (2009) Recommendations	<10%	<1%	>3% (EFA) >6% (CHD)	-

Estimated changes in the ratio of blood total to HDL-cholesterol when fat of average American diet is replaced with common dietary oils



RP Mensink et al. Meta-analysis of 60 controlled trials
Am. J. Clinical Nutrition, 2003; 77: 1146 - 1155.

Omega-3 from fish or fish oil can prevent heart disease

- Populations with high fish consumption (Japanese & Inuit) and persons who frequently eat fish have a low cardiovascular mortality.
- The cardiovascular benefits of fish consumption are due to the omega-3 polyunsaturated fatty acids, EPA and DHA.
- The most compelling evidence comes from an Italian study (GISSI study) conducted in 1999 that showed that fish oil could have a significant protective effect against cardiovascular diseases.

GISSI Preventione Study (Lancet 354, 447-55, 1999)

- 11 324 patients from Italy surviving recent (< 3 months) myocardial infarction were randomly assigned supplements of:
- Fish oil capsule (900 mg EPA +DHA) daily for 3.5 y.
- No EPA/DHA (control) for 3.5 years.
- Primary end-points: death, non-fatal myocardial infarction and stroke.

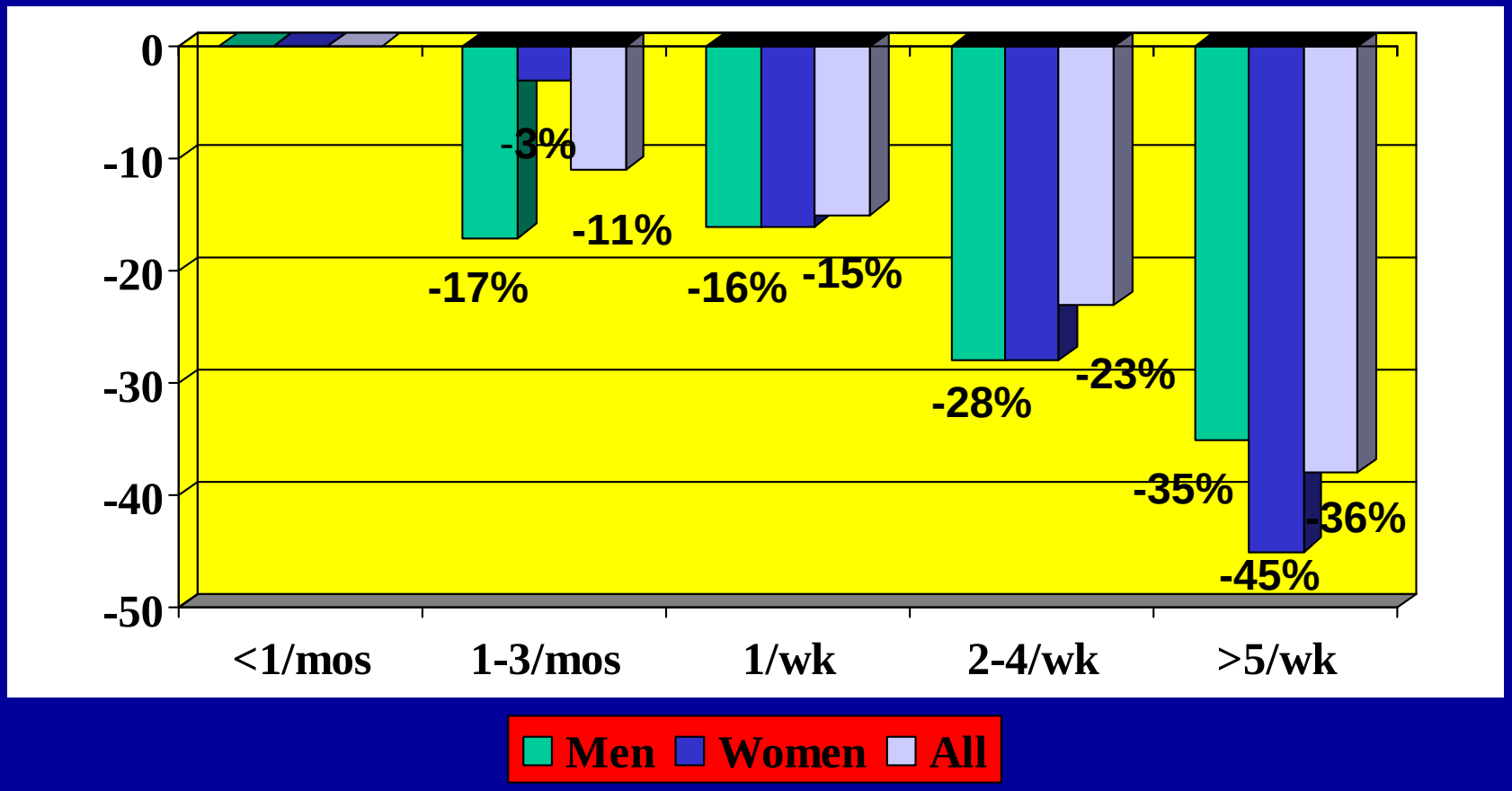
900 mg EPA +DHA= 100g fatty fish per day

Major findings of the GISSI study
(Lancet 1999)

Outcome	Control group (%)	Fish oil group (%)	Risk Reduction (%)
All cause mortality	10.6	8.4	21
Cardiovascular death	7.2	5.1	30
Sudden death	3.3	1.8	44

CHD Mortality and Fish Consumption

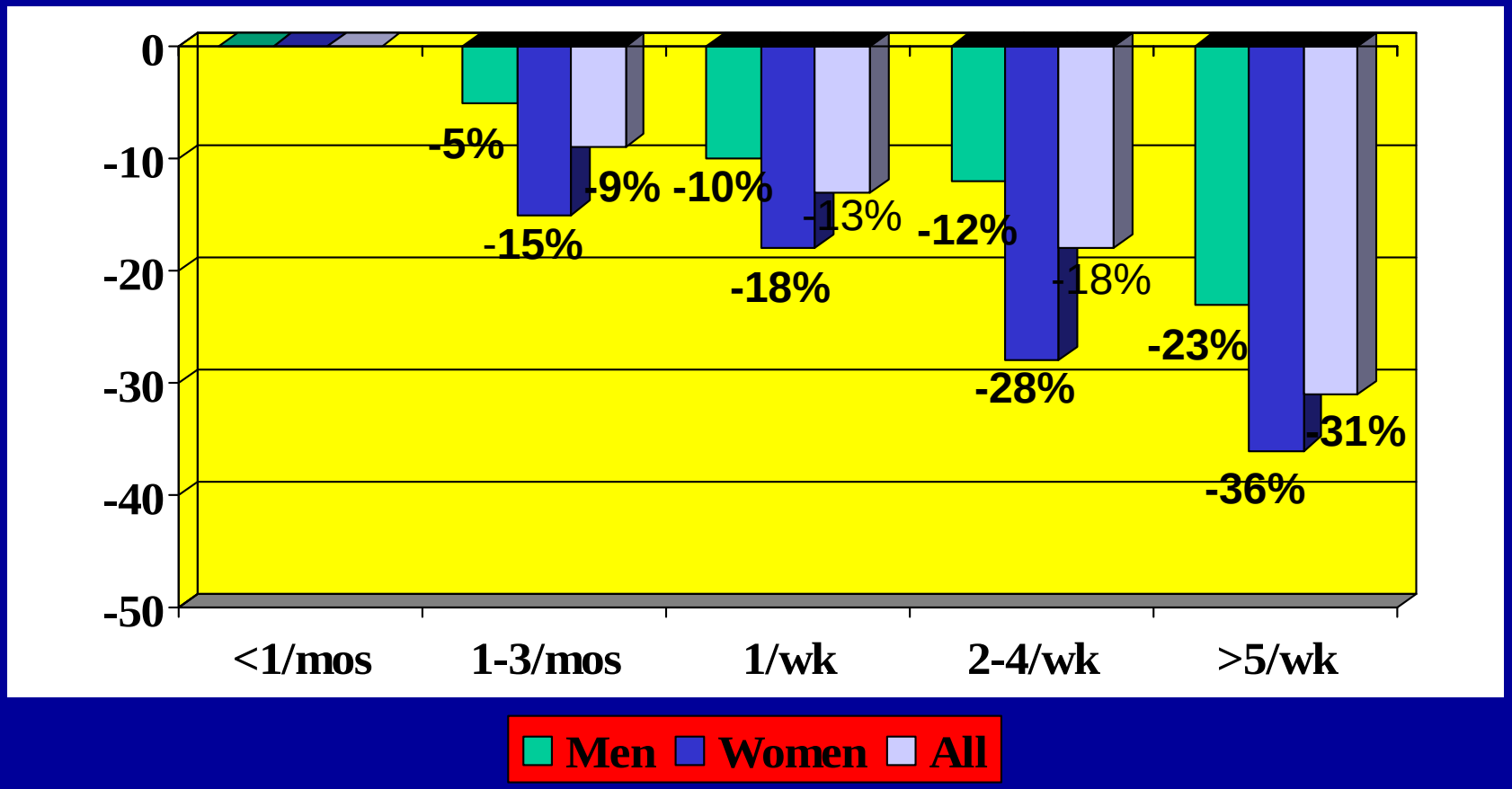
Meta-analysis of 13 cohort studies (222 364) subjects with 11.8 yr follow-up). He et al. Cir. 109:2705-11,2004



(Number of fish servings)

Stroke Mortality and Fish Consumption

Meta-analysis of 13 cohort studies (200 575) subjects with 12.8 yr follow-up). He et al. Stroke 35,1358-42,2004



(Number of fish servings)

Contributing mechanisms to the cardioprotective effects of EPA & DHA

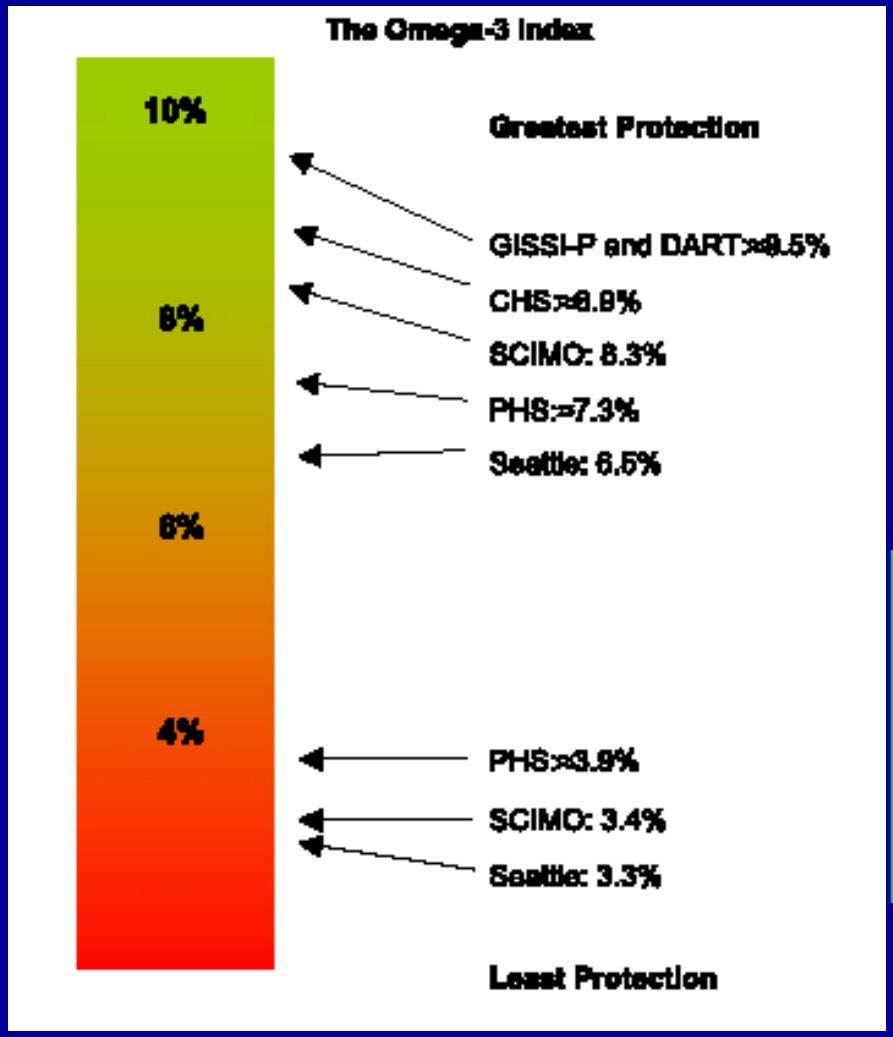
1)Reduce platelet reactivity, increase bleeding time, reduce blood viscosity-improve flow of blood in the body
2) Reduction in blood TG, but moderate rise in LDL-C
3) Improve endothelial relaxation (via enhancement of nitric oxide-relaxation dependent vasodilatation)
4) Inhibitory effects on atherosclerosis and inflammation (reduce expression cell adhesion molecules such as E-selectin, VCAM-1 and VCAM-2; aids in plaque development)

Holub & Holub, Mol Cell Biochem, 263:217-25, 2004
Ratnayake and Galli, Annals of Nutrition and Metabolism, 2009

How much fish (or EPA + DHA) do we need?

Organization	Fish/EPA + DHA mg/day
British Nutrition Foundation (2004)	Fatty fish twice a week - 500 mg
American Heart Association (2002)	Fatty fish twice a week- 550 mg 1000 mg for people with documented CHD
European Society of Cardiology (2003)	1000 mg for people with documented CHD
International Society for the Study of Fatty Acids and Lipids (2004)	500 mg
FAO/WHO (2009)	250 – 2000 mg
Health Canada (2009)	500 mg

Red Blood Cell Omega-3 (EPA +DHA) Index: a new risk factor for CHD



Omega-3 index of > 8% associated with lowest risk of CHD, whereas an Index of <4% is associated with the highest risk.

Omega-3 index of 8% can be achieved by consumption 2 servings of fatty fish per week (500 mg EPA +DHA)

Harris & von Schacky, Preventive Medicine 39:212-220 (2004)

Health benefits of EPA/DHA against mental disorders

- EPA and DHA are important in stabilizing or partially reversing neurological disorders such as
- Depression in adults
- Bipolar disorders in adults
- Memory problems as seen in Alzheimer’s disease and dementia

Health benefits of fish DHA in brain development

- DHA is required for the development brain, retina and central nervous system.
- Children whose mothers received DHA during their pregnancy and breast feeding have better IQ and eyesight than those who did not get the DHA boost.
- WHO recommendation: Pregnant and lactating mothers should achieve an average daily intake of 200 mg DHA
- Some infant formulas are fortified with DHA.

Content of EPA +DHA of Selected Fish/Seafoods

Product	EPA +DHA mg/100g	Serving of fish (3 oz or 84 g) per week needed to provide 500 mg EPA+DHA/day
Mackerel	2500	1.5
Herring	1700	2
Anchovy	1400	3.0
Salmon	1200	3.5
Smelt, capelin	700	6
Trout, rainbow	500	8.3
Halibut,Catfish, Tuna	400	10.4
Shrimp, cod	300	13.9

Fish Oil Capsules

Margarines fortified with Fish oil omega-3

600 mg omega-3 per 10 g margarine

Omega-3 eggs

75 mg omega-3 (as DHA) per egg
(vs, 20 mg in a regular egg)

Note: Dietary cholesterol has no or minimal effect on blood cholesterol levels

Coconut oil
Good or Bad for Heart Health?

- Feeding studies in humans, monkeys and rabbits have shown that coconut oil substantially elevates LDL-C.
- Has a powerful HDL-C boosting effect, but the net effect is to increase the ratio of LDL-C to HDL-C

Effects of partial replacement of coconut fat with unsaturated fats on plasma lipids of healthy volunteers from the Central Province of Sri Lanka

Nutrient	Preliminary Phase (2 wk) High CF (n =54)	Phase 1 (8 wk) Moderate CF (n=54)	Phase 2 (52 wk) A (n=28) Low CF	Phase 2 (52 wk) B (n=28) Low CF + test fat
Fat (% E)	31	25	20	24
Coconut fat (% E)	17.8	9.3	4.7	4.7
Test fat (% E) (SBO+sesame)	0	0	0	3.2
Unsats:Sats	0.2	0.4	0.7	1.1

Mendis, Samarajeewa & Thatil, Br J Nutr 2001;85:583-589

Effects of partial replacement of coconut oil with unsaturated fats on plasma lipids

Plasma Lipid	Baseline mmol/L (End of High CF)	End of Phase 1 (Mod CF) mmol/L	% Change from Phase 1 after 1 yr		AHA Recommended levels
			A Low CF	B Low CF+ test fat	
Total C	7.1	6.5*	-4.2	-4.0	<5.2 mmol/L
LDL-C	5.3	4.1*	-11.0	-16.2	<3.4 mmol/L
HDL-C	0.87	0.87	+33.6	+32.8	>1.0 mmol/L
TC:HDL-C	11.9	11.6	-23.8	-27.1	<4.6

Mendis, Samarajeewa & Thatil, Br J Nutr 2001;85:583-589

Effects of coconut oil, butter and safflower oil on plasma lipids of Polynesians living in NZ (37 subjects fed for 6 weeks)

	Butter	Coconut	Safflower
TC (mmol/L)	5.6[a]	5.5[a]	5.1[b]
LDL-C (mmol/L)	4.1[a]	3.8[b]	3.5[c]
HDL-C (mmol/L)	1.2[a]	1.2[a]	1.1[b]

Cox et al. Eur J Clin Nutr 1998: 52, 650-654

Take home message

- Primary effect of dietary fat on CHD is related to high intakes of saturated and trans fat.
- Cut down on saturated fats (coconut oil), increase PUFA consumption.
- Regular consumption of marine-derived omega-3 (EPA + DHA 500 mg /d or fatty fish twice a week) provides many beneficial health effects: protection from heart disease, reduce the risk of stroke, positive effects on inflammatory disorders, mental disorders.

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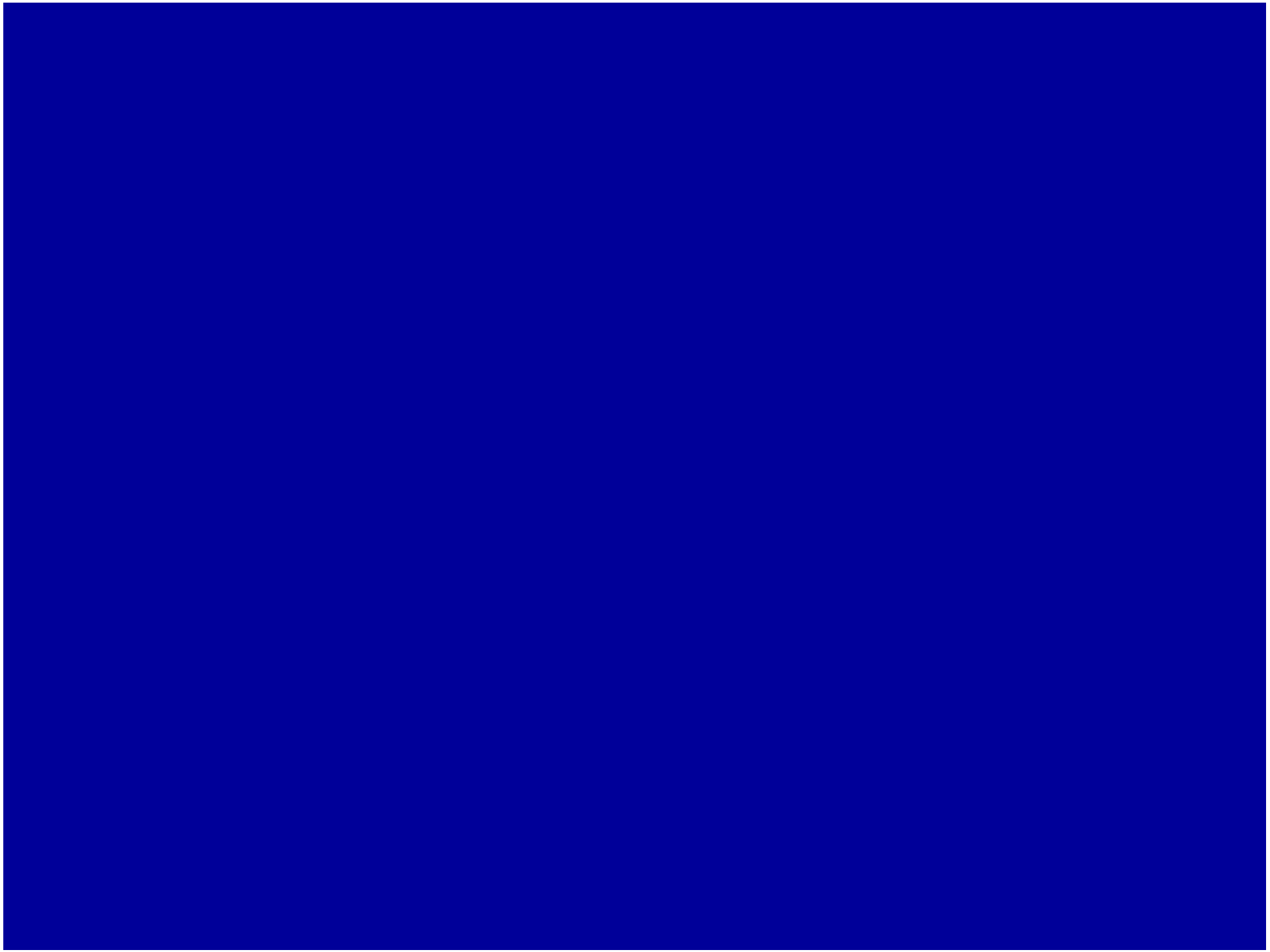

A small case control study in Kerala found no association between coconut oil and CHD

Intake	CHD Patients (n=32)	Controls (n=16)
Coconut oil (ml/day)	13.6	12.5
SFA (g/day)	31	29

Note: Coconut oil and SFA intakes are significantly higher in Sri Lanka (41 and 58 g/day, Mendis et al. 2001)

PD Kumar, Tropical Doctor 1997: 27:215-217

Case control study in West Sumatra: No association between coconut consumption and CHD

- Coconut consumption as flesh or milk was not different between cases and controls (42 vs. 38 g/d)
- Similar intakes of saturated (14.3 vs 13.9 % E) and unsaturated (8.7 vs 9.5% E) fatty acids between cases and controls .
- Dietary fat, including that from coconut is not a predictor for CHD in this study group.
- Flaws: Small case control study (only 93 cases); Errors in estimating food intake. Current diet has a strong influence on recall of previous diets for the preceding 12 months.

Lipoeta et al. Asia Pac J Clin Nutr 2004: 13, 377-84

Prevalence of hypertension of Karalites consuming high saturated fat in relation to type of fat intake

Type of fat	Number of subjects	Prevalence
Coconut oil + butter	158	57%
Coconut oil	152	45%
Coconut oil + Vegetable oil (PUFA)	120	32%

Beegom and Singh, Int J Cardiol 1997:58:63-70