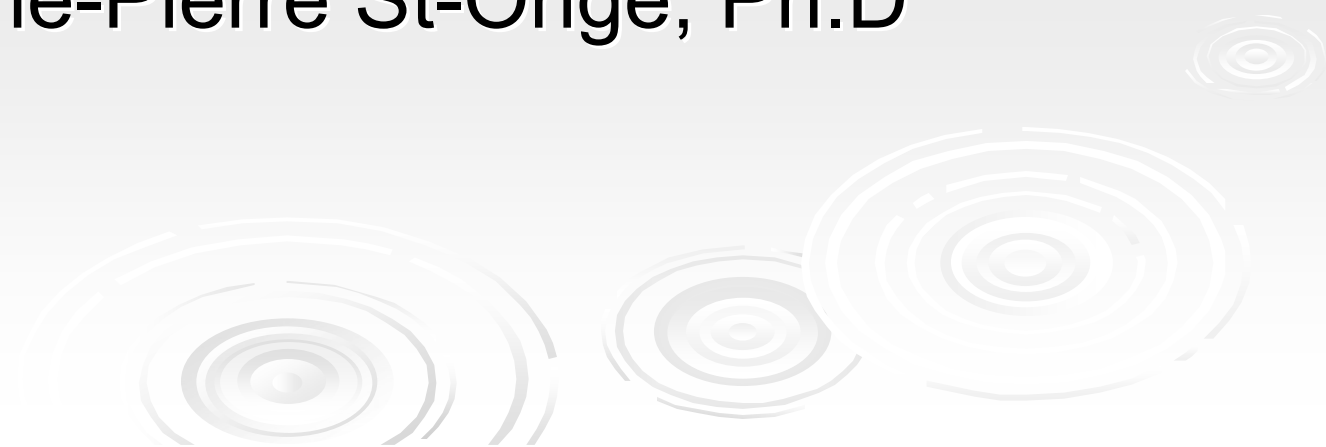


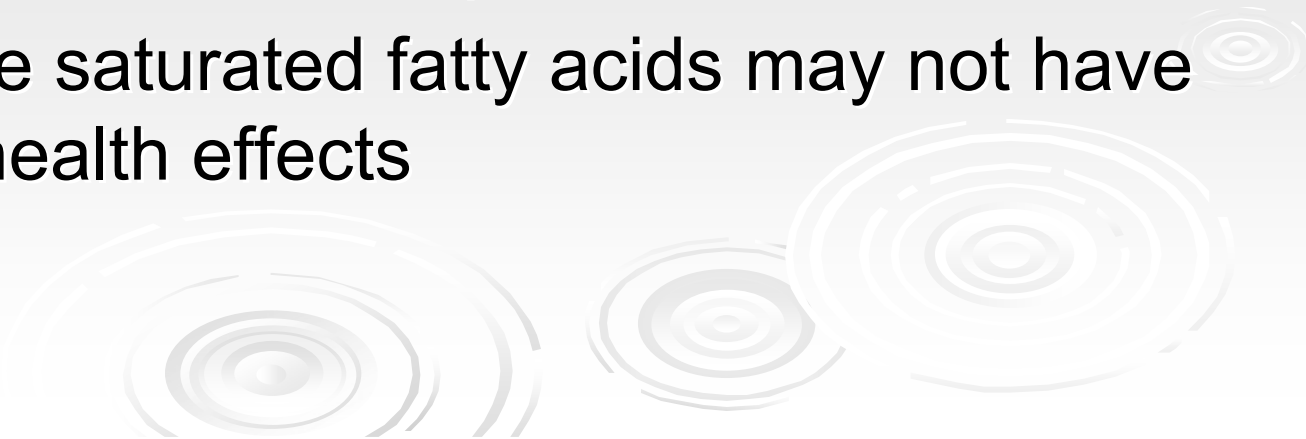
The Skinny on Total Fat: A Matter of Quality vs. Quantity

Marie-Pierre St-Onge, Ph.D



Goals

- Impact of low-fat vs moderate fat diets on cardiovascular disease risk
- Impact of saturated fats vs polyunsaturated and monounsaturated fats on cardiovascular disease risk
- All saturated are not equal...
 - How some saturated fatty acids may not have adverse health effects



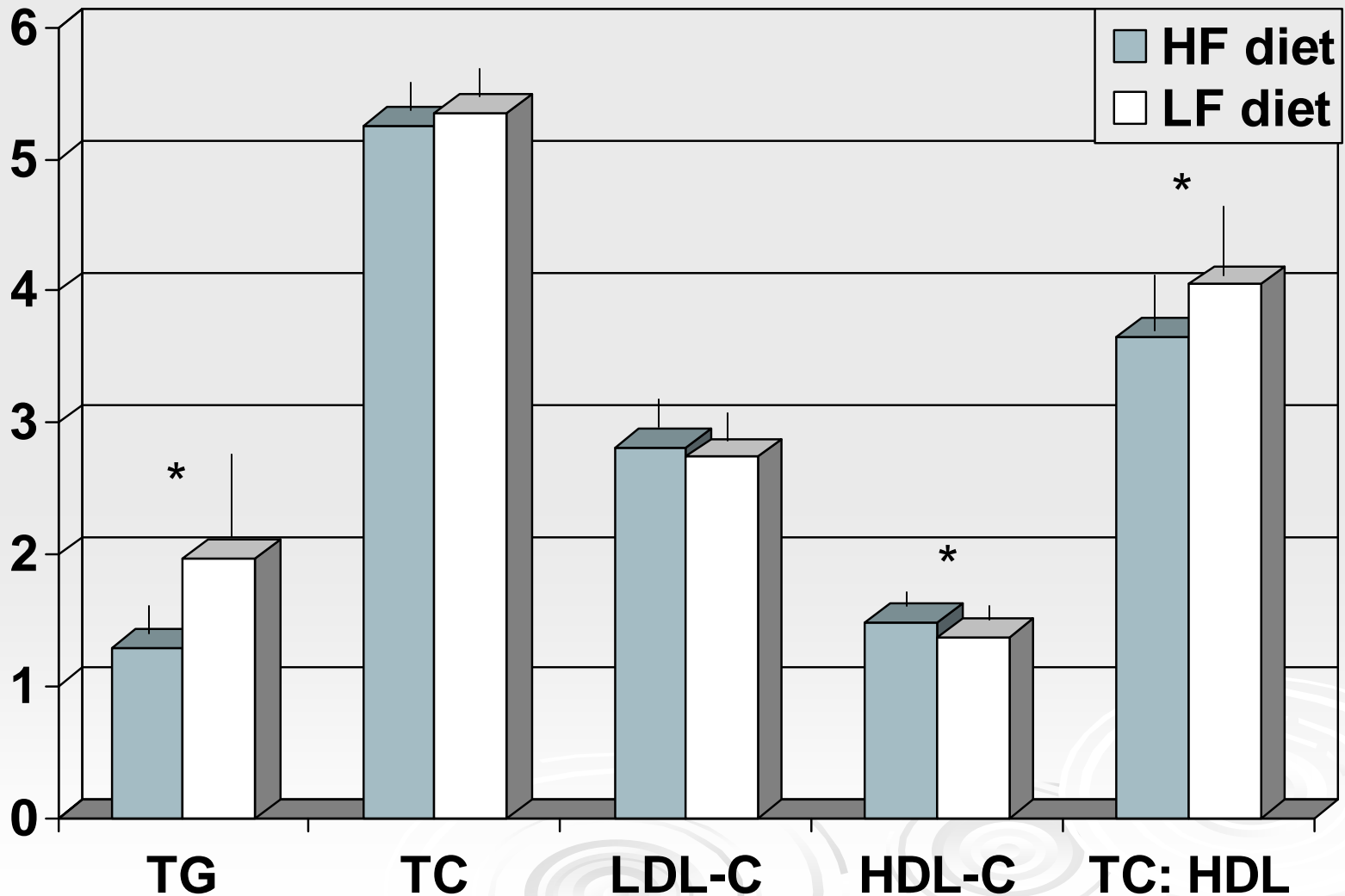
Impact of low-fat vs moderate fat diets on CVD risk--Overview

- Typical low-fat diets:
 - <30% of energy from fat
 - <25% of energy from fat
 - NCEP Step 1, <10% of energy from SFA
 - NCEP Step 2, <7% of energy from SFA
- Typical moderate fat diets:
 - Approximately 35% of energy from fat
 - Typically <10% of energy from SFA

Controlled feeding study of low-fat diets for CVD risk reduction

- Post-menopausal women
- 2 diets for 3 weeks each:
 - 15% pro / 45% fat / 40% carbs
 - 15% pro / 25% fat / 60% carbs
 - Same dietary cholesterol content
 - Same ratio of P/S/M = 1.0/1.0/1.2
- Measured fasting lipid concentrations after each phase

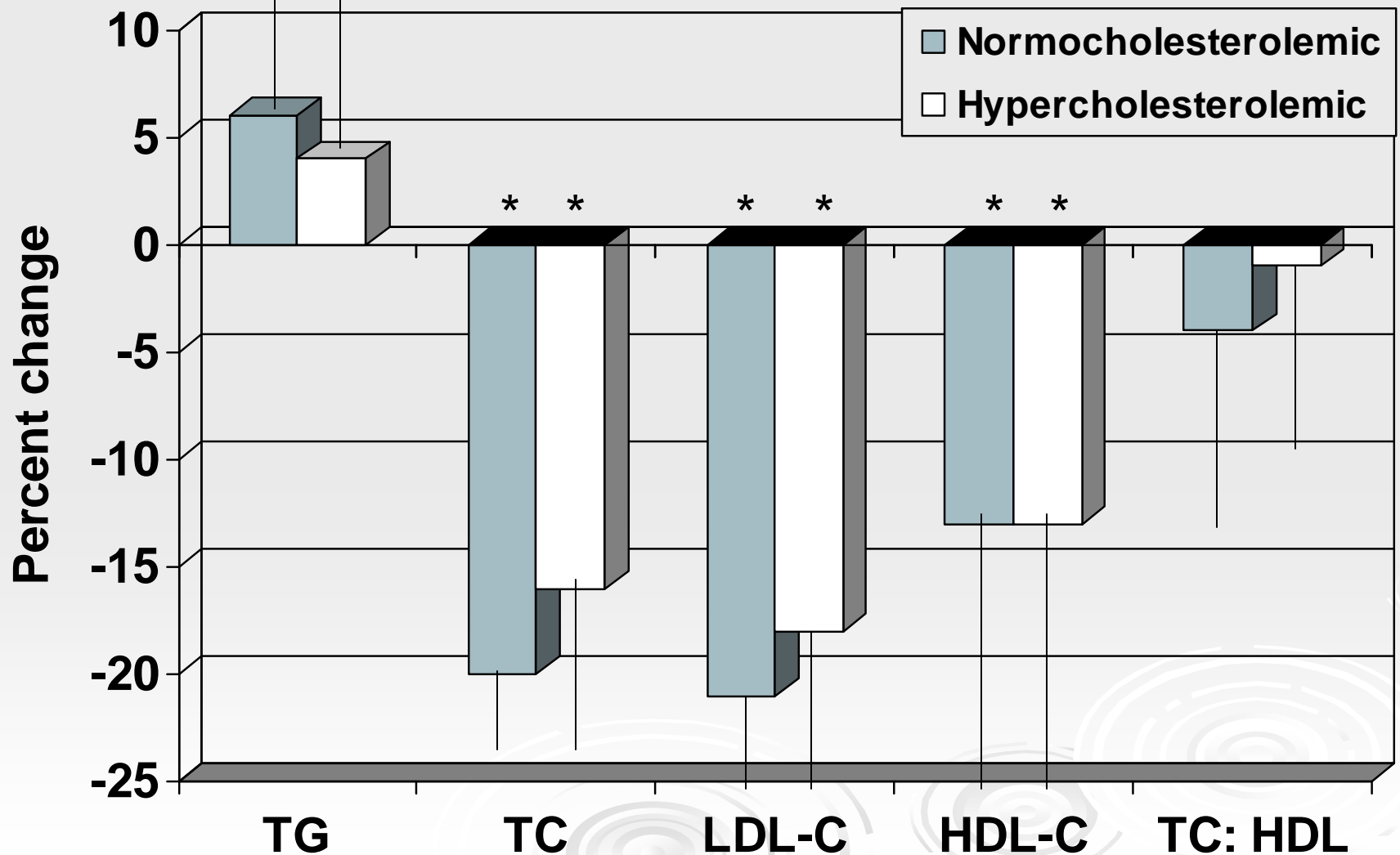
Controlled feeding study of low-fat diets for CVD risk reduction



Controlled feeding study of NCEP Step 2 diet for CVD risk reduction

- Post-menopausal women & men age >40
- Baseline diet for 6 weeks
 - 35.4% of energy as fat, 14.1% of energy as SFA, 147 mg cholesterol/1000 kcal
- NCEP Step 2 diet for 24 weeks (normo-cholesterolemic) or 6 weeks (hyper-cholesterolemic)
 - 25.5% of energy as fat, 4.0% of energy as SFA, 45 mg cholesterol/1000 kcal

Controlled feeding study of NCEP Step 2 diet for CVD risk reduction



Controlled feeding study of NCEP Step 2 diet for CVD risk reduction


- LDL particle score increased significantly with NCEP diet in hypercholesterolemic subjects
 - Higher score = smaller, denser LDL particles
 - Small, dense LDL particles are associated with increased risk of CVD



Free-living low-fat diet for CVD risk reduction

- 10 men and women
- 2 diets for 3 weeks each, 1 week washout:
 - 20% pro / 19% fat / 61% carbs
 - 20% pro / 50% fat / 30% carbs
 - Same intended ratio of P/S/M
- Self-selected foods, sample menus provided
 - Counseled to use ADA exchange list diet & serving size
 - Food intake recorded after each meal

Free-living low-fat diet for CVD risk reduction

- Measured fasting lipid concentrations after each phase
 - Baseline diets contained approximately 30% of energy from fat
 - Compared 3 diets:
 - 19% of energy from fat
 - 50% of energy from fat
 - 30% of energy from fat
- 

Free-living low-fat diet for CVD risk reduction

Parameters	Dietary Fat		
	30% (regular diet)	19%	50%
Glucose (mg/dL)	87 ± 2	84 ± 3	86 ± 2
NEFA (mEq/L)	0.3 ± 0.03	0.4 ± 0.07	0.4 ± 0.04
TG (mg/dL)	83 ± 7	85 ± 10	72 ± 11
TC (mg/dL)	183 ± 8	174 ± 10	189 ± 10
HDL-C (mg/dL)	56 ± 3 ^a	54 ± 3 ^a	63 ± 3 ^b ←
LDL-C (mg/dL)	110 ± 10	103 ± 11	111 ± 10
TC:HDL-C	3.4 ± 0.3	3.3 ± 0.3	3.0 ± 0.3
HDL-C:LDL-C	0.6 ± 0.1	0.6 ± 0.1	0.7 ± 0.1
Apo-A1 (mg/dL)	126 ± 3 ^a	118 ± 4 ^b	127 ± 3 ^a ←
Apo-B (mg/dL)	67 ± 4	66 ± 4	69 ± 4
ApoA1:ApoB	2.0 ± 0.2	1.8 ± 0.2	1.9 ± 0.2

Women's Health Initiative

Why quality may be more important than quantity

- Primary aim was testing whether low fat consumption, along with increased fruit, vegetable, and grain consumption would decrease the incidence of breast and colorectal cancer in postmenopausal women
- Secondary aim was to assess CVD risk
- Women were randomized to intervention or usual diet and followed for 8.1 y

Women's Health Initiative

Why quality may be more important than quantity

➤ Intervention group:

- Counseled to reduce fat intake to 20% of energy
- Increase intake of fruits & vegetables to 5 servings/d
- Increase intake of grains to ≥ 6 servings/d
- Assumed that reduction in total fat would reduce saturated fat intake to 7% of energy
- 18 group sessions in y 1 and 4/y thereafter

➤ Control group:

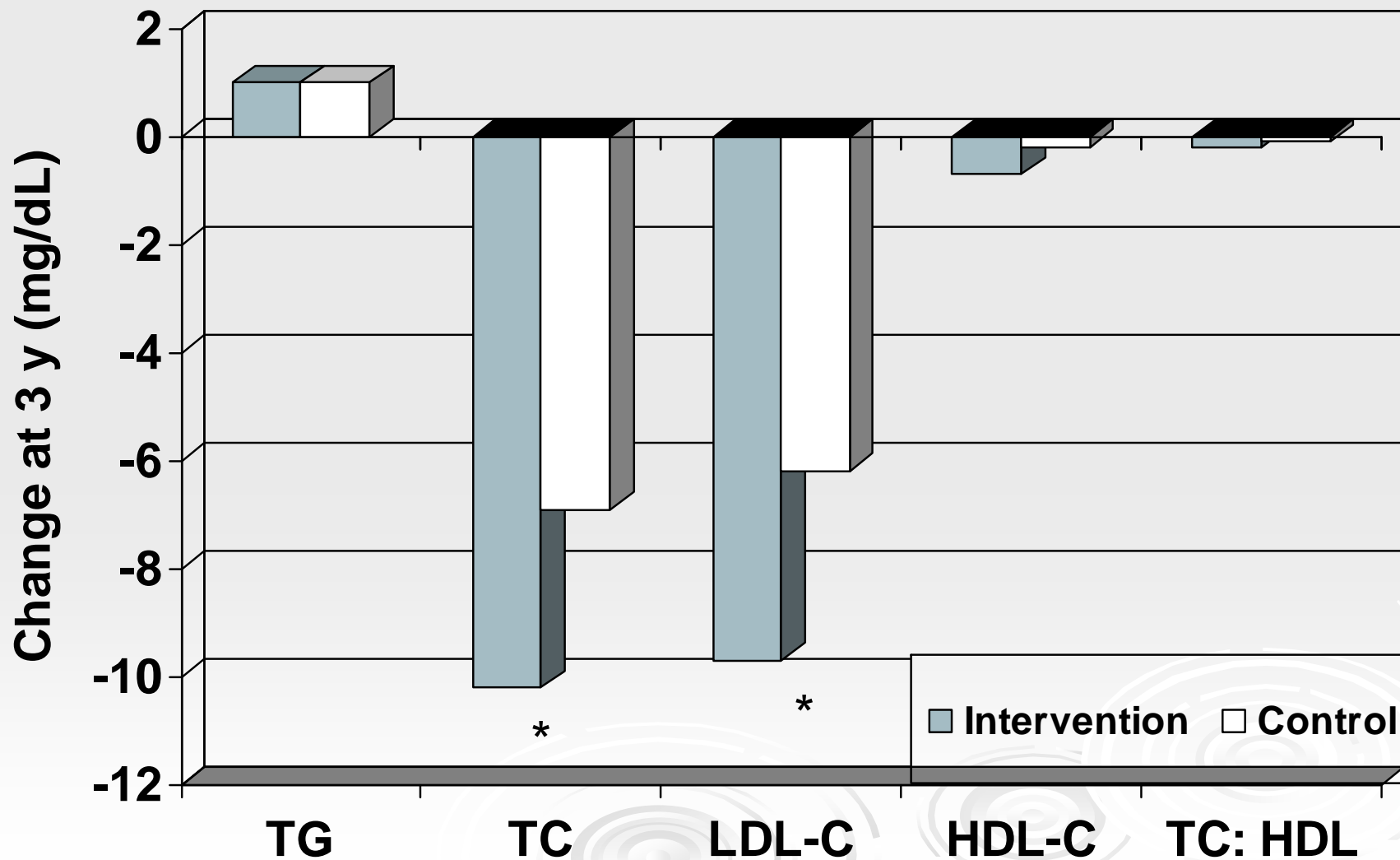
- Received a copy of the Dietary Guidelines for Americans and other health-related materials

Women's Health Initiative

	Baseline		1 year		6 years	
	Interv	Ctrl	Interv	Ctrl	Interv	Ctrl
Energy, kcal/d	1790	1789	1500	1594	1432	1546
Fat, %	37.8	37.8	24.3	35.1	28.8	37.0
SFA, %	12.7	12.7	8.1	11.8	9.5	12.4
MUFA, %	14.4	14.4	8.9	13.3	10.8	14.2
PUFA, %	7.8	7.8	5.2	7.2	6.1	7.5
Trans, %	2.7	2.8	1.6	2.5	1.8	2.4

* Differences between groups at 1 and 6 years are all significant

Women's Health Initiative



Lessons learned from the WHI

- Women have difficulty keeping a low-fat diet:
- Simple recommendations to reduce total fat does not necessary lead to drastic reductions in saturated and trans fat:

% total fat	Baseline	1 year	6 years
SFA	33.6	33.3	33
MUFA	38	36.6	37.5
PUFA	20.6	21.4	21.1
Trans	7.1	6.6	6.3

- Women in the low-fat group had lower body weight and waist circumference
- Differences in lipid levels were small and did not lead to significant reductions in CHD/stroke

Effects of the Mediterranean diet rich in olive oil or nuts on CVD risk

➤ Mediterranean diet:

- Typically higher in fat ~35% of energy
- Rich in olive oil and vegetable oils
- Rich in fruits and vegetables, nuts, fish, legumes, and wine
- Low in red meats and high fat meats, preference towards white meats



Effects of the Mediterranean diet rich in olive oil or nuts on CVD risk

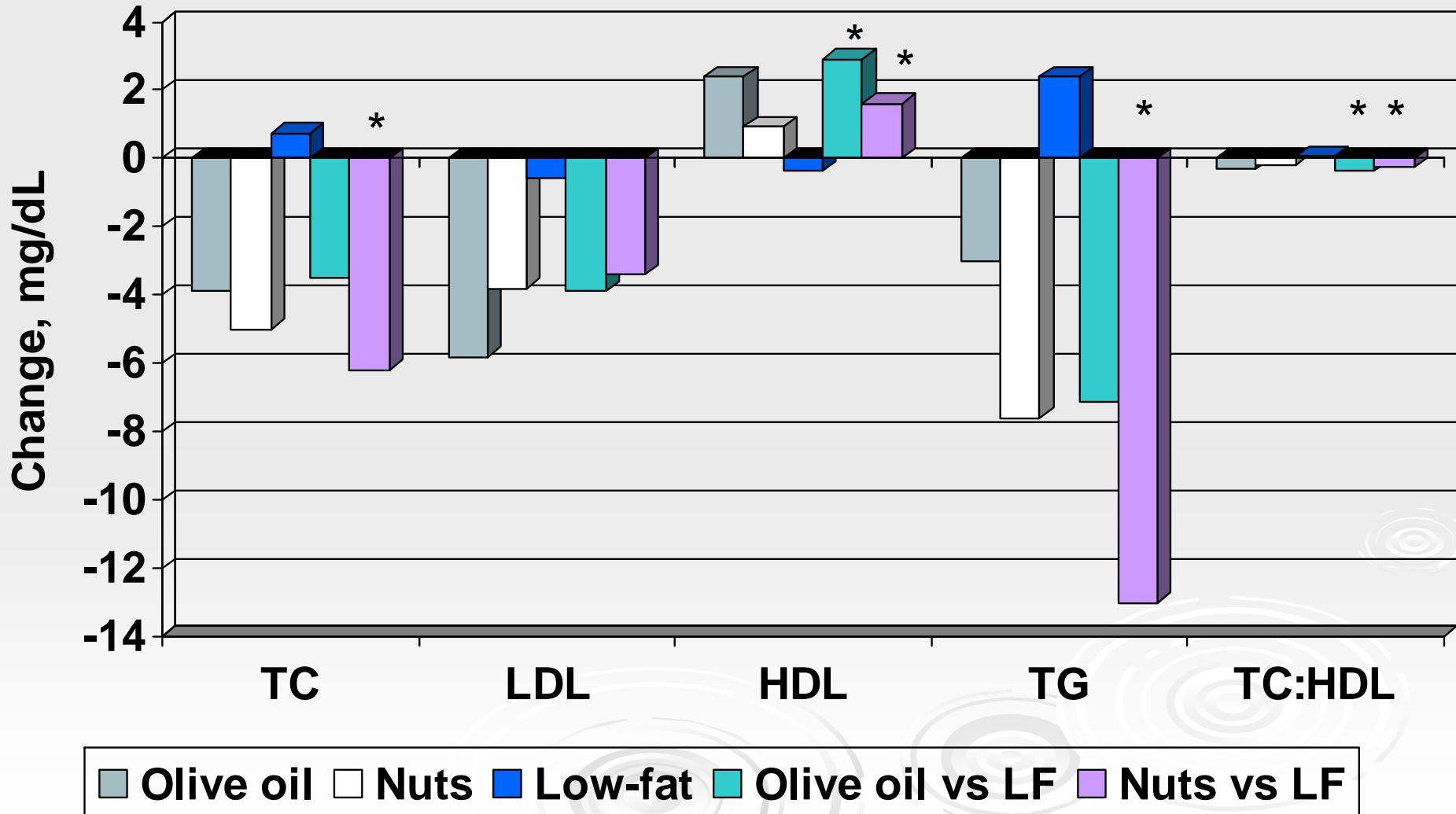
➤ PREDIMED Study

- Large, parallel-group, multi-center study

➤ 3 intervention groups:

- Low-fat = reduce intake of all fats
- Mediterranean diet rich in olive oil = increase Mediterranean diet score with olive oil
- Mediterranean diet rich in nuts = increase Mediterranean diet score with nuts (walnuts, hazelnuts, almonds)
- 3 month intervention

Effects of the Mediterranean diet rich in olive oil or nuts on CVD risk

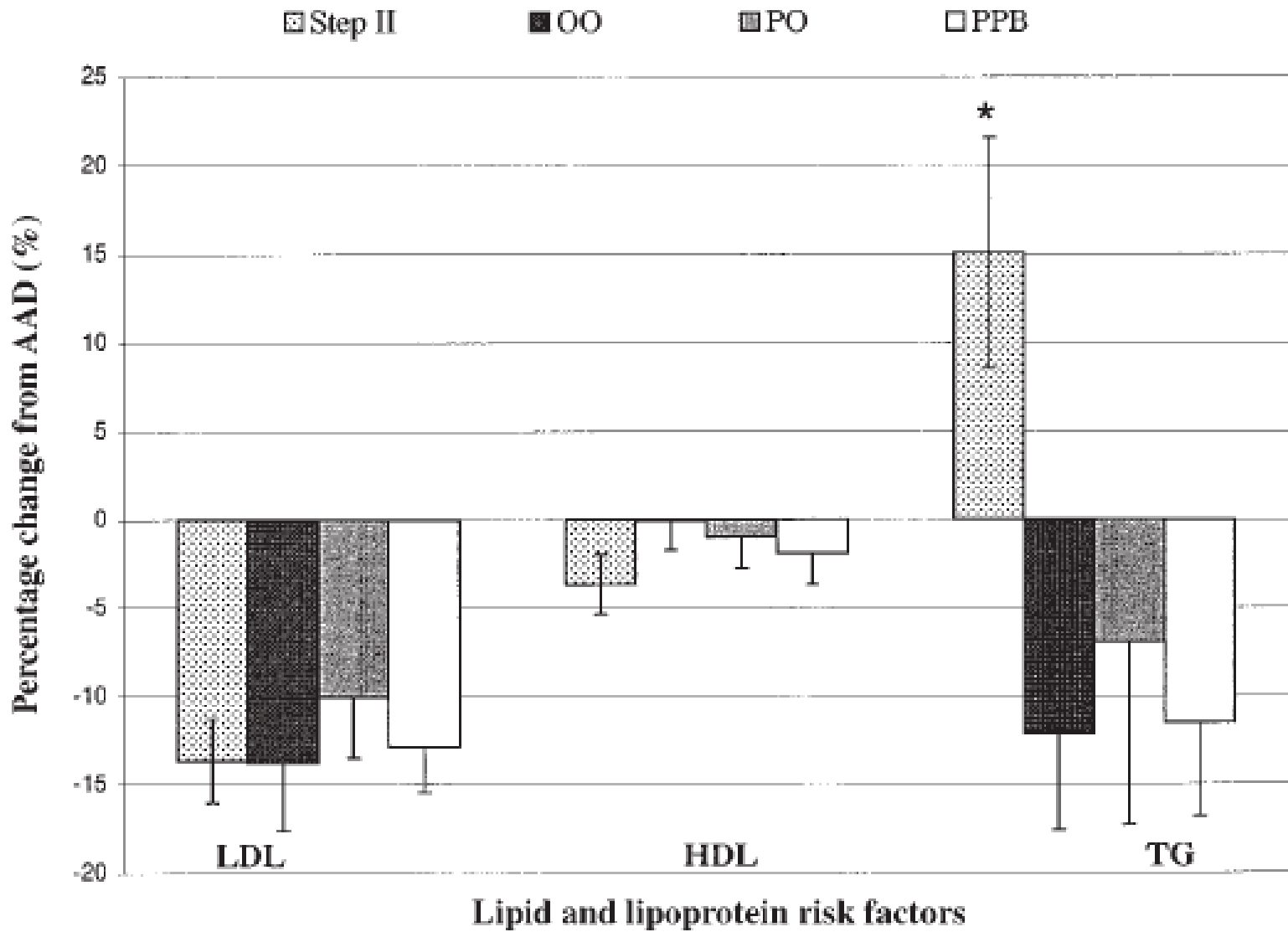


Saturated fat & CVD risk: Clinical evidence

- Controlled feeding study of 4 diets
- Fed 4 weeks each

Dietary constituent	AAD	Step II	OO	PO	PPB
Carbohydrate (% of energy)	50	59	50	50	47
Protein (% of energy)	16	16	16	16	17
Fat (% of energy)	34	25	34	34	36
SFAs	16	7	7	7	8
MUFAs	11	12	21	17	18
PUFAs	7	6	6	9	10
Cholesterol (mg/d) ²	400	200	200	200	200

Saturated fat & CVD risk: Clinical evidence

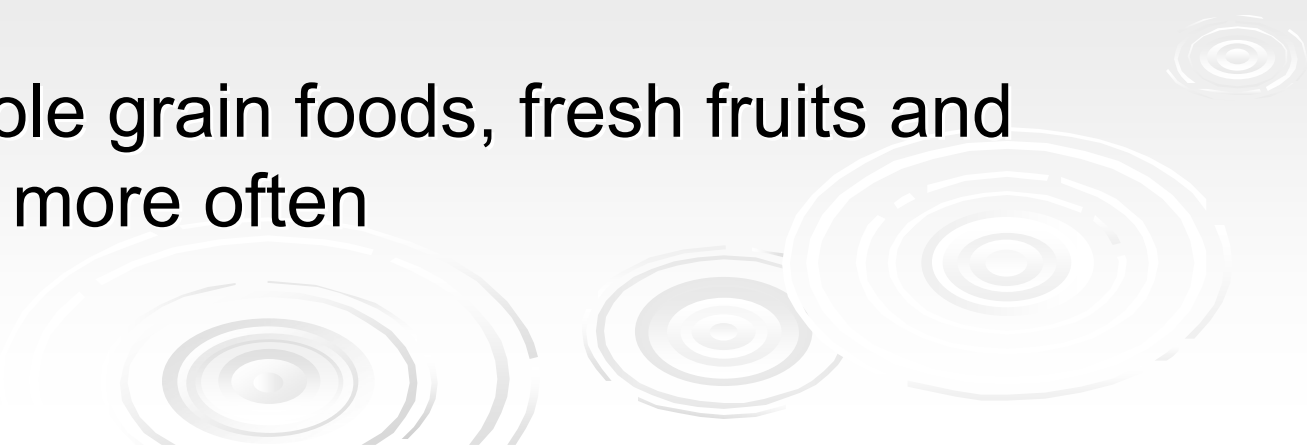


Dietary Recommendations

➤ Early recommendations:

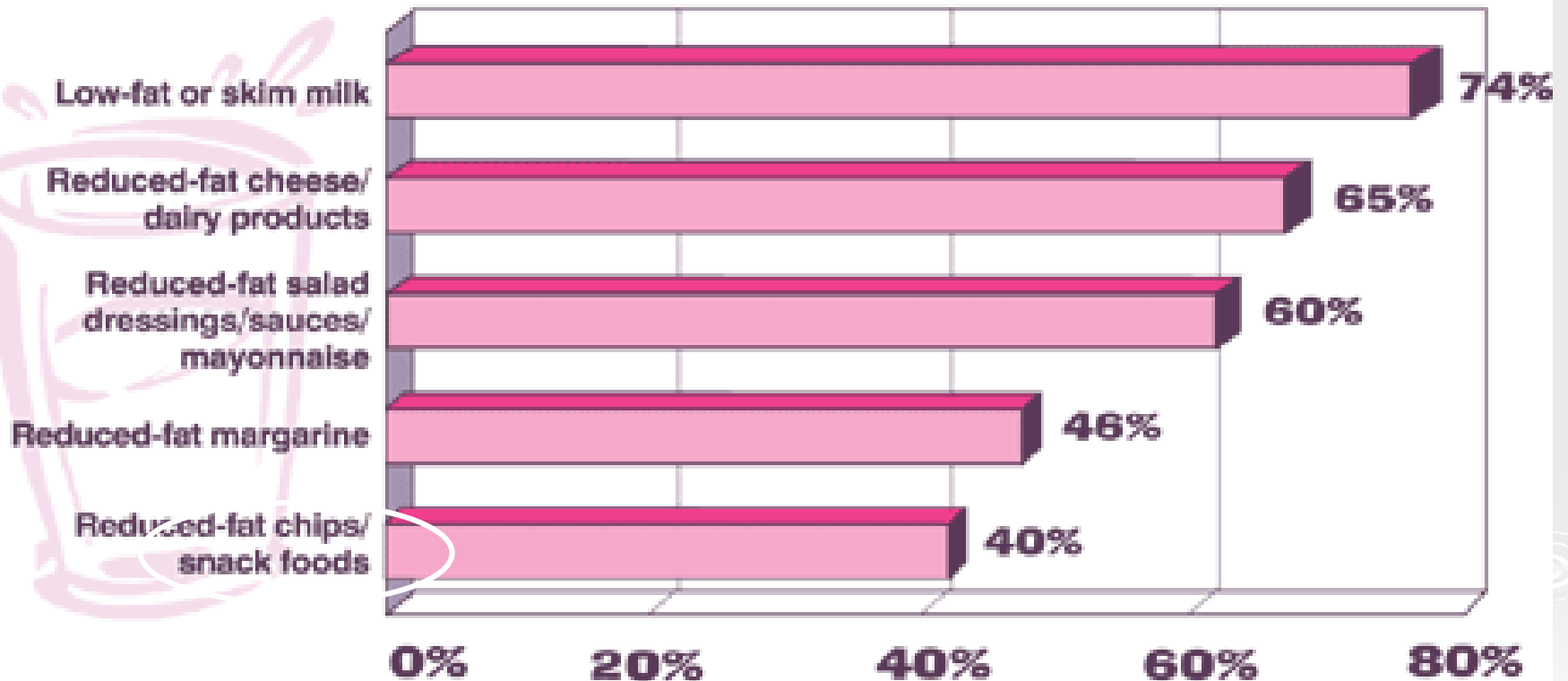
- reduce total fat to $< 30\%$ of calories and saturated fat to $< 10\%$ of calories

➤ New recommendations:

- emphasis on liquid oils, ie. fats rich in polyunsaturated and monounsaturated fatty acids
 - choose whole grain foods, fresh fruits and vegetables more often
- 

Most Popular Reduced-Fat Products

(% of adult Americans who consume...)



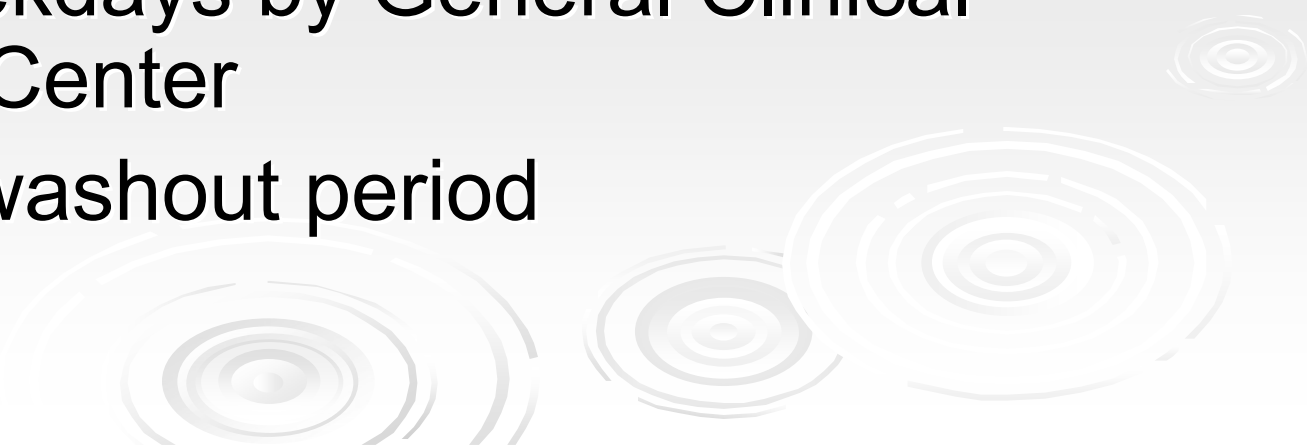
Source: Calorie Control Council National Consumer Survey, 2004.

Study Goal

- To examine the effects of isocaloric substitution of high-polyunsaturated fat snacks for low-fat or high-fat/high-saturated fat snacks on cardiovascular disease risk factors



Study Design

- Randomized, cross-over, controlled feeding
 - 3 phases, 25 d each
 - All diets had same base foods, only snacks differed
 - Weight maintenance diets provided daily during weekdays by General Clinical Research Center
 - 4-8 week washout period
- 

Target Population

- Men & Women
- Non-smokers
- Age 19-65 y
- BMI 20-35 kg/m²
- Weight stable
- LDL-C 130-180 mg/dL
- TG < 350 mg/dL
- Glucose < 126 mg/dL
- Blood pressure < 140/90 mmHg
- Not diabetic

Study Diets

- Study provided ~ 300 kcal of snacks/day
 - 1 snack = 100-150 kcal
- 300 kcal of snack = 12-15% of energy
 - 17.7% of energy in general US population in 1996

Nielsen et al., *Obes Res* 2002;10:370-8



Study Diets

Nutrient	Lower-fat	High PUFA	Higher-fat
Carbohydrate, %	54.8	48.6	46.0
Protein, %	14.7	15.5	16.3
Fat, %	30.8	36.3	37.9
PUFA, %	5.2	9.7	5.8
MUFA, %	14.2	15.3	15.9
SFA, %	8.5	8.5	11.4
Trans, %	1.2	0.7	2.7
Fiber, g/d	20.1	22.2	20.9
Sodium, mg/d	3546	3491	3622

Nutrient Content of Snacks

Nutrient	Lower-fat	High PUFA	Higher-fat
Carbohydrate, g (%)	63.65 (84.9)	32.81 (43.8)	34.93 (46.6)
Protein, g (%)	4.21 (5.6)	3.51 (4.7)	3.67 (4.9)
Fat, g (%)	3.17 (9.5)	17.19 (51.6)	16.25 (48.8)
PUFA, g (%)	0.50 (1.5)	9.44 (28.3)	1.62 (4.8)
MUFA, g (%)	0.72 (2.2)	5.02 (15.1)	5.19 (15.6)
SFA, g (%)	1.42 (4.3)	2.82 (8.5)	8.86 (26.6)
Trans fatty acids, g (%)	0.60 (1.8)	0.11 (0.32)	0.85 (2.6)

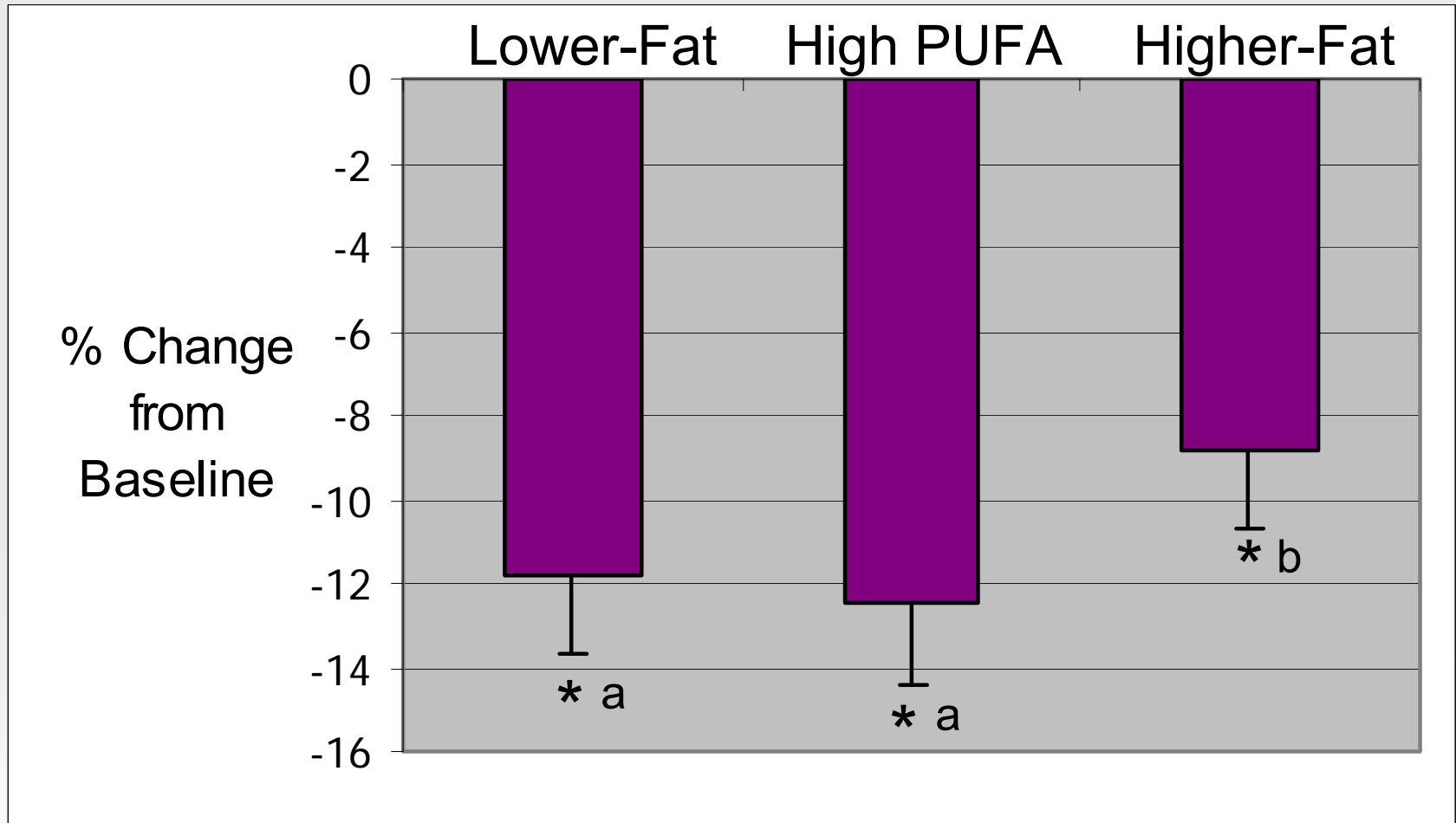
Values based on 300 kcal serving.

Study Sample

- 45 enrolled, 33 completed
- Reasons for drop-out:
 - Straying from diet (2)
 - Work conflict (1)
 - Food complaints (5)
 - Death in family (1)
 - Pregnant (1)
- Characteristics of sample:

Characteristic	Mean (SD)
Men/Women	7/26
Age, y	41.8 (1.9)
BMI, kg/m ²	29.0 (0.6)
LDL-C, mg/dL	147.5 (2.0)
TG, mg/dL	111.6 (8.6)
Glucose, mg/dL	94.1 (1.2)

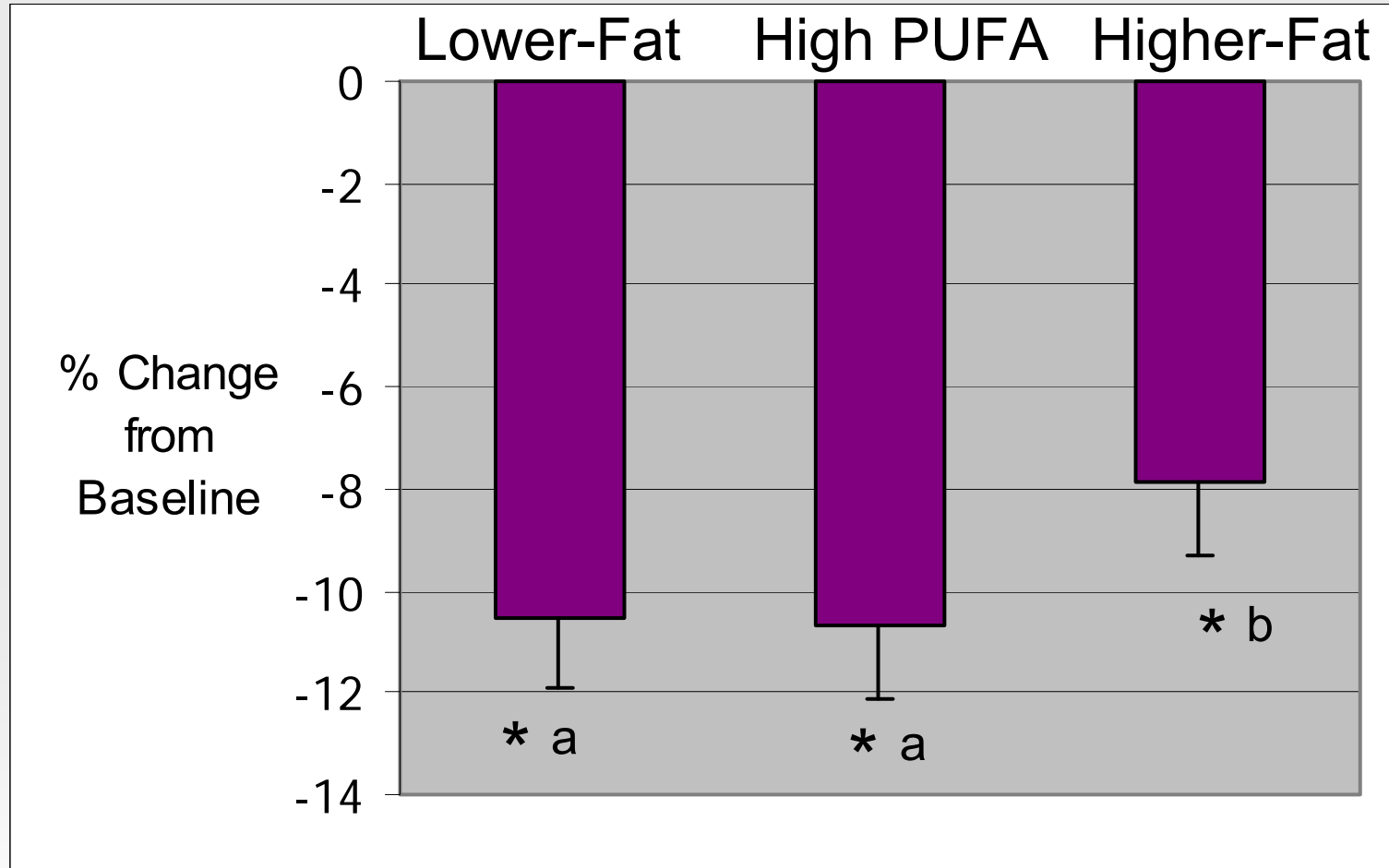
Change in LDL-Cholesterol with Consumption of Diets Differing in Type of Snack



* Significantly different from zero

Bars with different letters are significantly different from each other

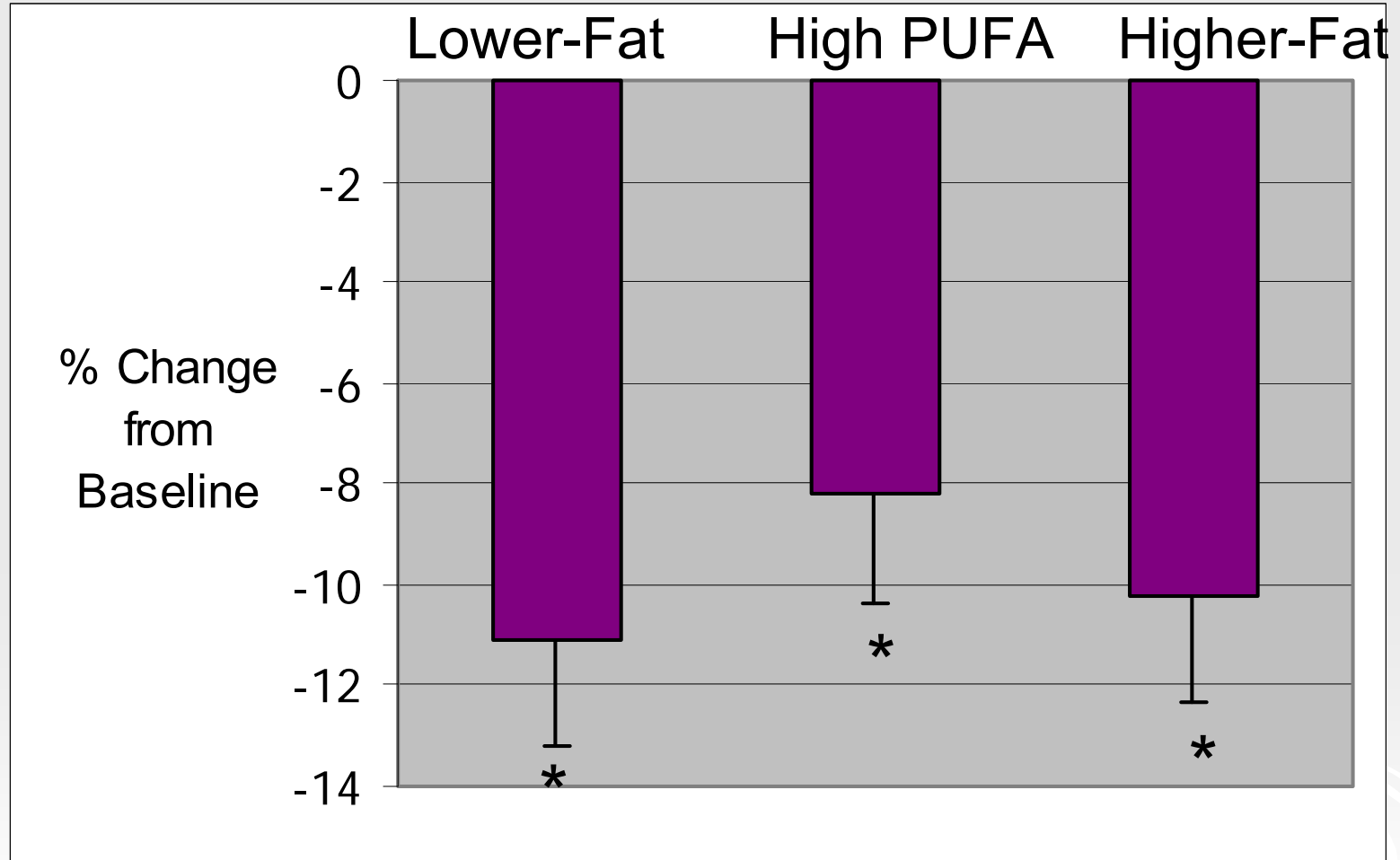
Change in Total Cholesterol with Consumption of Diets Differing in Type of Snack



* Significantly different from zero

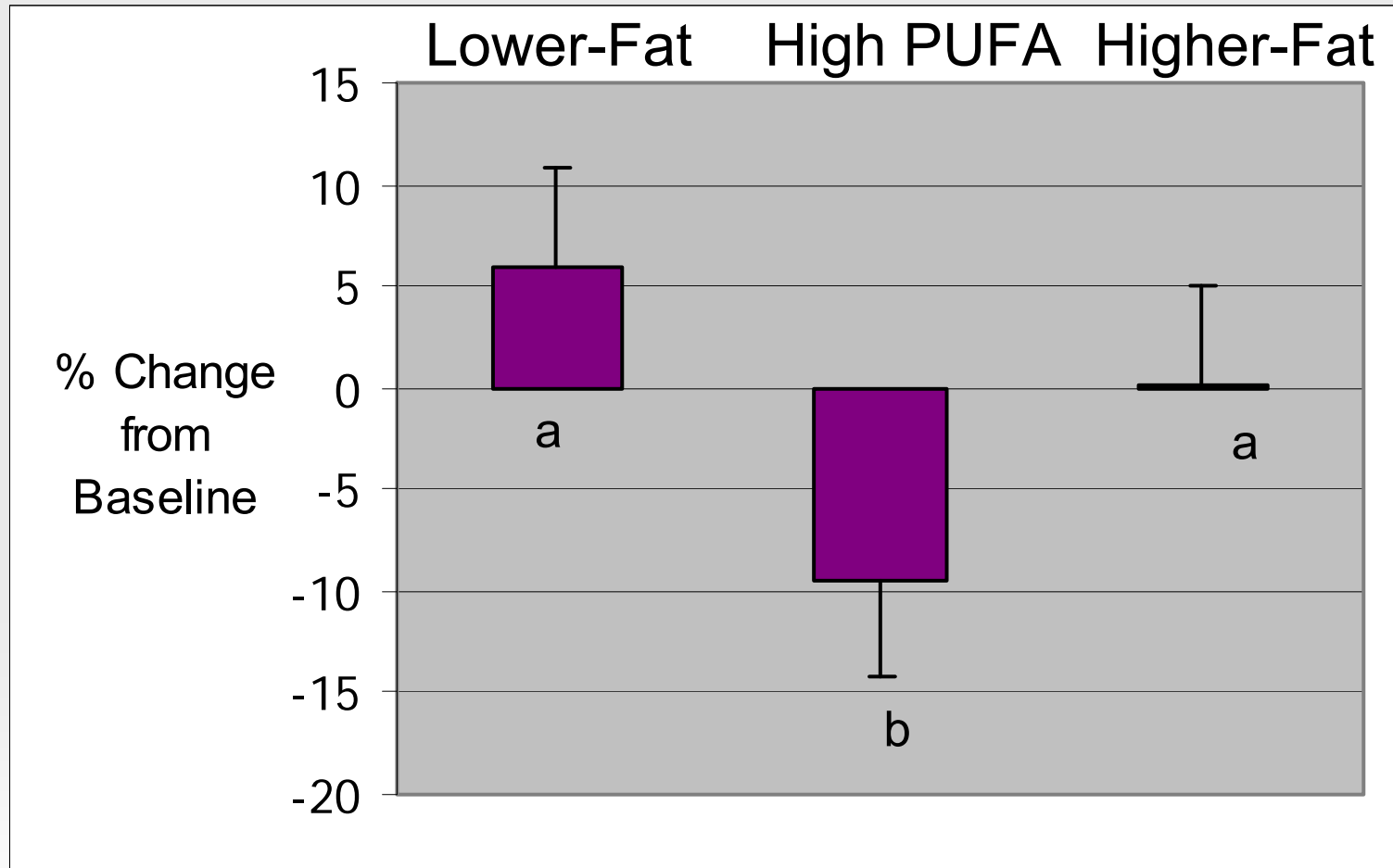
Bars with different letters are significantly different from each other

Change in HDL-Cholesterol with Consumption of Diets Differing in Type of Snack



* Significantly different from zero

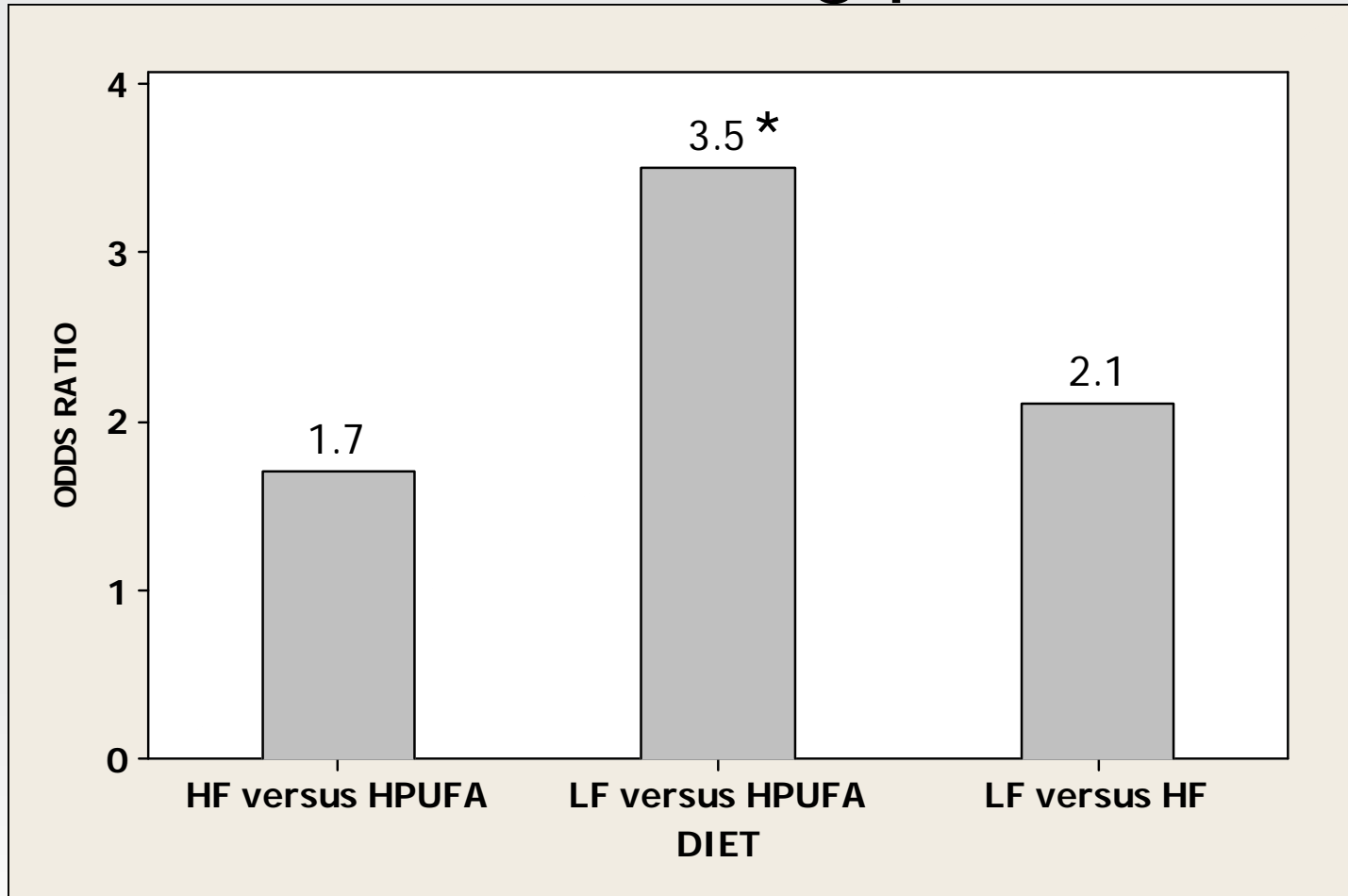
Change in Triglycerides with Consumption of Diets Differing in Type of Snack



Bars with different letters are significantly different from each other

LDL Particle Type: A or B?

-The odds of having pattern B-



* Significantly different from 1

Putting it All Together...

Variable	LF	HPUFA	HF
LDL-C	↓	↓	↓
TC	↓	↓	↓
HDL-C	↓	↓	↓
TG	-	-	-
Lp_a	-	-	-
LDL density		↑	

What This Study Shows...

- Snack choice can impact overall cardiovascular health
- Choosing snacks rich in polyunsaturated fats and low in saturated and trans fats leads to greater improvements in cardiovascular disease factors than choosing other high fat and low fat snacks

Complicating or de-simplifying saturated fats...!

- All saturated fats do not have the same effects on CVD risk factors
- Depending on their chain lengths, some saturated fats may be considered neutral for CVD risk
 - Medium chain triglycerides??
 - Myristic acid?
 - Stearic acid



Effect of saturated fat vs poly- and monounsaturated fat diets on CVD risk

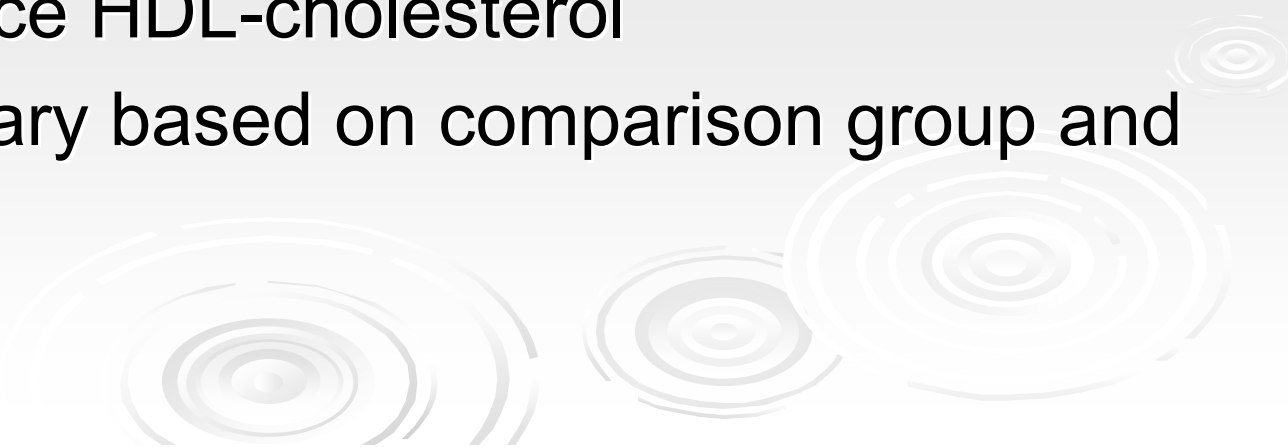
- Young healthy men with normal cholesterol levels were fed 4 controlled diets for 4 wks:
 - Cocoa butter
 - Olive oil
 - Soybean oil
 - Butter

Effect of saturated fat vs poly- and monounsaturated fat diets on CVD risk

Diet	TC	LDL	HDL	LDL/HDL	TG
CB	165 ± 3	103 ± 3	44 ± 2	2.3 ± 0.1	87 ± 3
B	176 ± 3	113 ± 3	45 ± 2	2.5 ± 0.1	88 ± 3
OO	152 ± 3	92 ± 3	48 ± 2	2.0 ± 0.1	84 ± 3
SO	139 ± 3	83 ± 3	45 ± 2	1.9 ± 0.1	73 ± 3

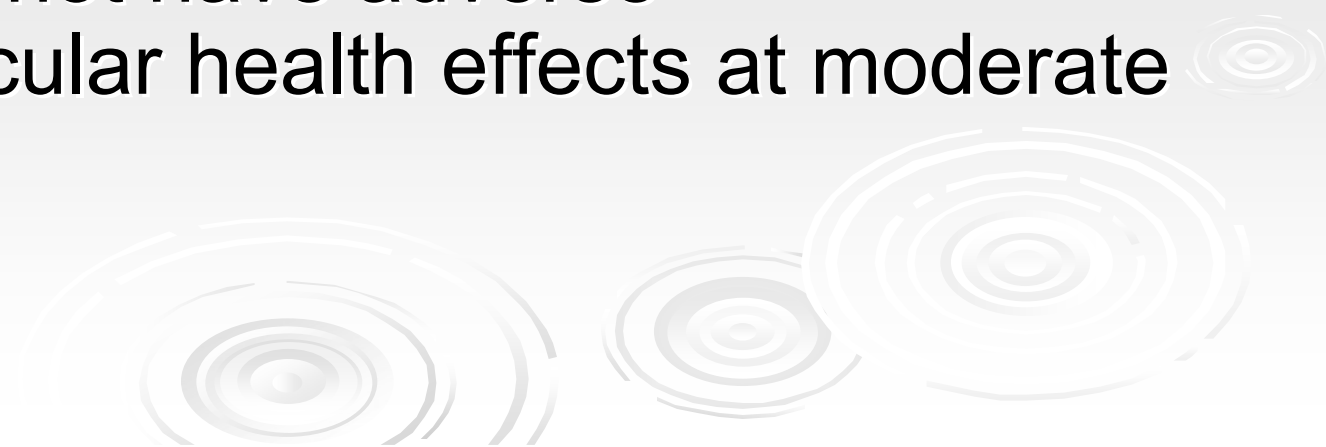
Conclude that stearic acid is hypocholesterolemic and that linoleic acid is more potent than oleic acid in decreasing total cholesterol levels

Saturated fatty acid chain length influences its effects on CVD risk...

- Medium chain triglycerides contain saturated fatty acids of 8-10 carbon chain lengths
 - At large doses, tend to increase total cholesterol concentrations and triglycerides in some studies
 - May reduce HDL-cholesterol
 - Results vary based on comparison group and dose
- 

Saturated fatty acid chain length influences its effects on CVD risk...

- Recent 16-week weight loss study providing 22-28 g/d MCT oil or olive oil showed:
 - Greater weight loss in the MCT group
 - No difference in fasting lipids, glucose, and insulin between groups
- MCT may not have adverse cardiovascular health effects at moderate doses



All things considered...

- Higher fat intakes, when unsaturated, can produce beneficial health effects for CVD risk
- Not all saturated fats are equal in their effects on CVD health, however, until labeling becomes much more sophisticated, recommendations to reduce saturated fat in the diet should be conveyed

What should I be looking for to keep in line with the recommendations?

➤ Nutrition facts:

- Higher levels of PUFA and MUFA
- Lower levels of saturated and trans fats

➤ Ingredient list:

- Non-hydrogenated
- Vegetable oil
- Canola oil, sunflower oil, corn oil, olive oil
- Nuts

