open.michigan

Author: Melvyn Rubenfire, M.D., 2009

Citation Key

for more information see: http://open.umich.edu/wiki/CitationPolicy

Use + Share + Adapt

{ Content the copyright holder, author, or law permits you to use, share and adapt. }

- **Public Domain – Government:** Works that are produced by the U.S. Government. (17 USC § 105)
- **Public Domain – Expired:** Works that are no longer protected due to an expired copyright term.
- **Public Domain – Self Dedicated:** Works that a copyright holder has dedicated to the public domain.
- **Creative Commons – Zero Waiver**
- **Creative Commons – Attribution License**
- **Creative Commons – Attribution Share Alike License**
- **Creative Commons – Attribution Noncommercial License**
- **Creative Commons – Attribution Noncommercial Share Alike License**
- **GNU – Free Documentation License**

Make Your Own Assessment

{ Content Open.Michigan believes can be used, shared, and adapted because it is ineligible for copyright. }

- **Public Domain – Ineligible:** Works that are ineligible for copyright protection in the U.S. (17 USC § 102(b)) *laws in your jurisdiction may differ

{ Content Open.Michigan has used under a Fair Use determination. }

- **Fair Use:** Use of works that is determined to be Fair consistent with the U.S. Copyright Act. (17 USC § 107) *laws in your jurisdiction may differ

  Our determination **DOES NOT** mean that all uses of this 3rd-party content are Fair Uses and we **DO NOT** guarantee that your use of the content is Fair.

  To use this content you should **do your own independent analysis** to determine whether or not your use will be Fair.

Nutrition and Cardiovascular Disease

Melvyn Rubenfire MD

Professor of Internal Medicine

Division of Cardiovascular Medicine

Director of Preventive Cardiology

Fall 2009

University of Michigan
Medical School

Nutrition and Cardiovascular Diseases-

- Dietary abuse and heart disease
  - Anorexia, obesity, alcohol,
- Congestive heart failure
- Atherosclerotic CV Disease
  - prevent and reduce progression of atherosclerosis
  - reduce MI, stroke, cardiac death, sudden death
- Cardiac risk factors:
  - LDL-C, insulin, VLDL-C, triglycerides, HDL-C, glucose, metabolic syndrome
- Hypertension

Good nutrition and CV disease- what it is!

- Maintain ideal body weight
- Adequate vitamins and minerals
- Fruits, vegetables, grains, nuts, fibers
- Fish
- Low or non fat dairy
- Monounsaturated fats
- Alcohol in moderation
- Limited salt

BY-NC François @ Edito.qc.ca (flickr)

BY-SA Eric Kilby (flickr)

BY-NC chotda (flickr)

BY-NC chotda (flickr)

Case anorexia nervosa

29 year old woman has practiced law for several years. Complains of palpitations each night on going to bed, and lightheadedness after exercise. She works out for about 90 minutes each day on treadmill and weights. Menstrual cycle has been irregular for years.

BP 90/50 mmHg, HR 80 bpm

Ht 5’ 6”, Wt 95 lbs. Facial skin drawn. Very lean and muscular, scaphoid abdomen with no body fat stores.

Anorexia nervosa - clinical profile

- Primarily young women
- on very low fat and low calorie diets to lose weight to maintain self image of thin
- may exercise to excess

Cardiac effects of anorexia nervosa

- Myocardial fibrosis and atrophy
- Unstable BP
- Complex arrhythmia’s including sudden death

Case obesity heart disease

42 year old obese man referred to cardiology for shortness of breath, fatigue, and pre-syncope. Long standing obesity: at age 15 - 240lbs, at 25 yrs - 290 lbs, and presently 5’ 9” 351lbs.
Eats about 6000 calories per day and 10-12 grams of salt. Fired from job because of falling asleep at work.
PE: Loud sonorous breathing, drowsy, facial flushing. BP 180/100 mmHg with large cuff, HR 110 bpm, respiration shallow 24/min, facial plethora, bilateral rhonchi, distant heart sounds, morbid generalized and trunkal obesity with large panus, minimal leg edema,

Hgb 20.2 g/dl, Hct 61%, arterial p02 - 55mmHg, and 02 sat 88%

Cardiovascular effects of obesity

- Effects of obesity on CV risk
  - Hypertension
  - Diabetes
  - Low HDL
  - when central or abdominal is associated with the metabolic syndrome
- Obesity heart disease
  - Sleep disordered breathing
  - Cardiomyopathy

Obesity and CVD

PD-INEL Ashrafian, et al. Circulation 2008

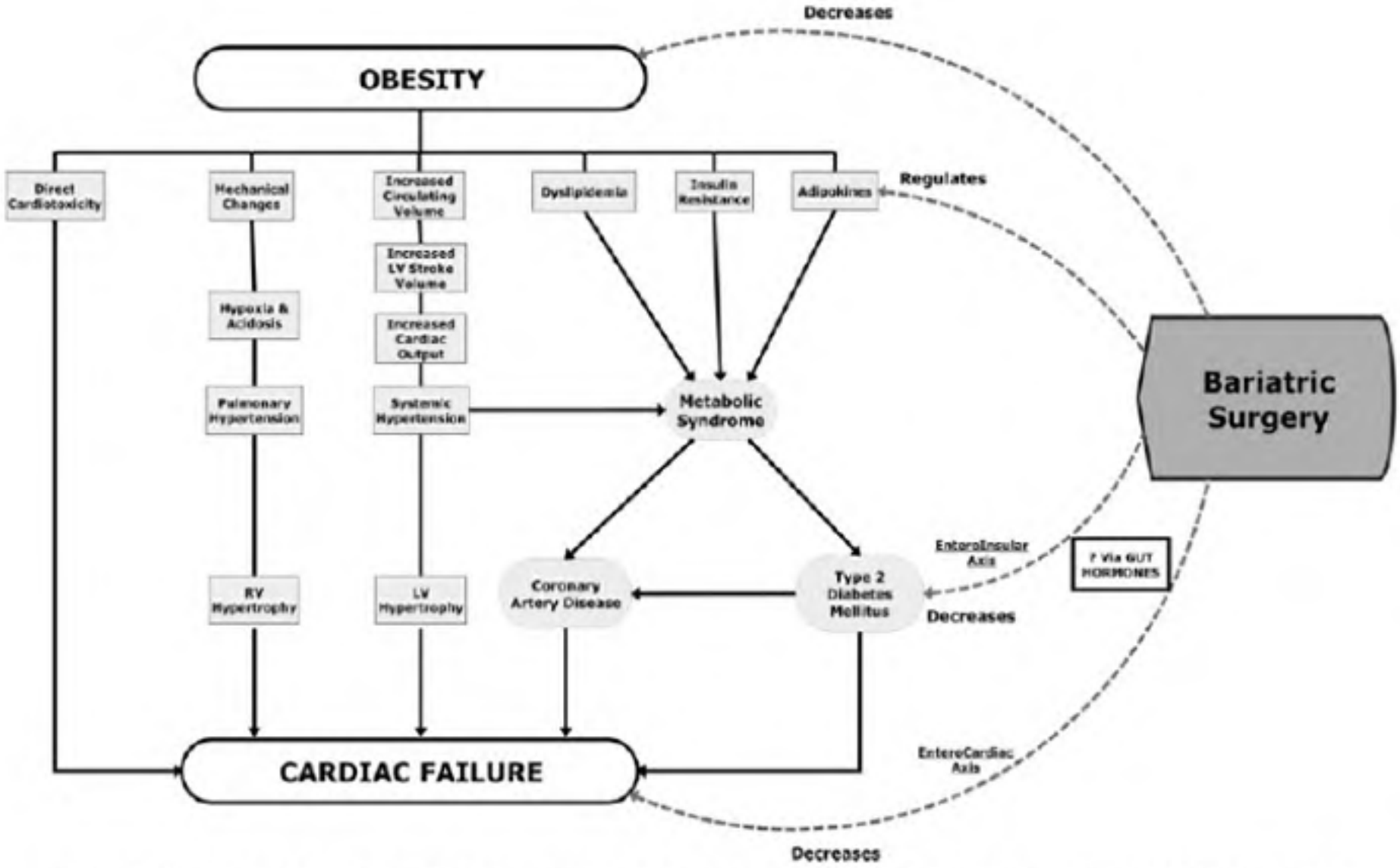


Figure 1. Obesity, cardiac failure, and the beneficial role of bariatric surgery. RV indicates right ventricular; LV, left ventricular.

Impact of weight loss on atherosclerotic risk in obesity

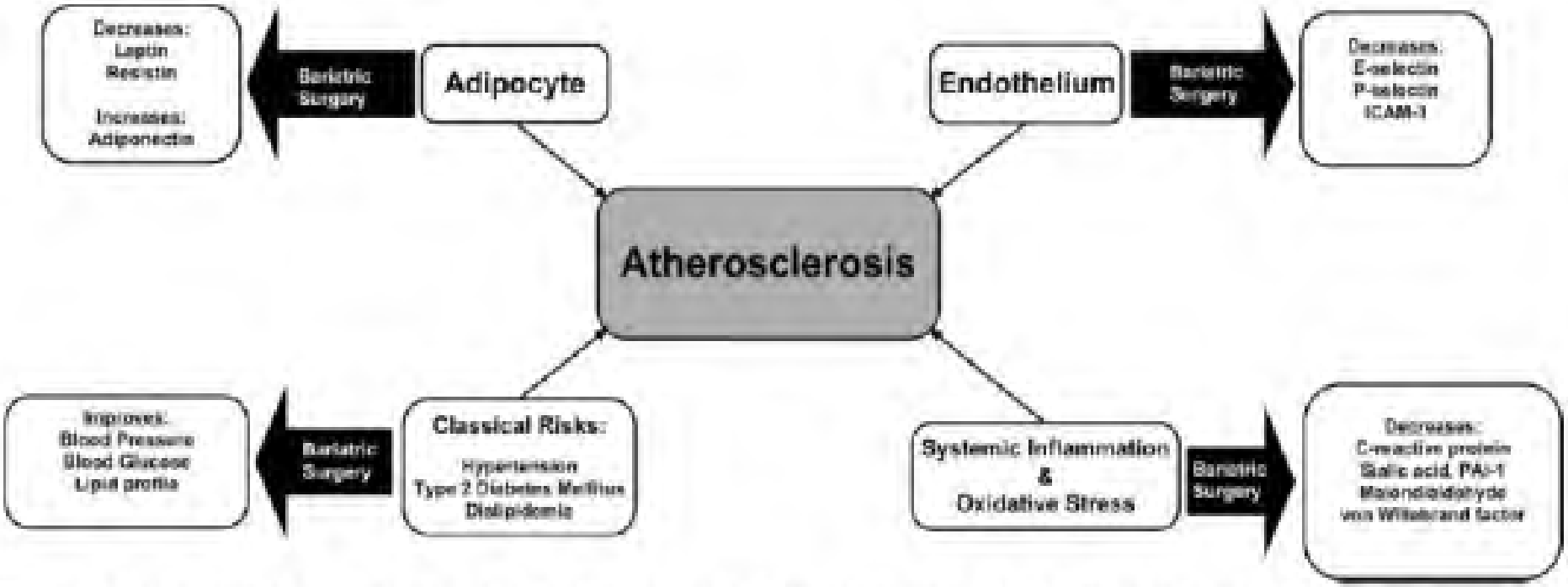


Figure 2. Mechanisms of atherosclerosis and the beneficial role of bariatric surgery. ICAM-1 indicates intercellular adhesion molecule-1; PAI-1, plasminogen activator inhibitor-1.

PD-INEL Ashrafian, et al. Circulation 2008

Nutrition case alcoholism

35 year man was old found lying on his apartment floor by his sister, stuporous, and hyperventilating.

History of alcoholism since teens. In ER admits to 1 to 2 fifths of gin daily and not much food other than taco chips.

Mildly confused, tremulous, and hyperventilating. Cachexia with loss of muscle mass.

BP 150/50, HR 120, increased JVP, lung rales, diffuse sustained apical impulse, loud S3 gallop, ascites, liver enlarged and tender, edema of legs, scrotum, and buttocks.

Cardiovascular complications of alcohol

- Direct toxin or myocardial depressant
- Cardiomyopathy
  - CHF
  - Can be acute CHF
- Arrhythmia's
  - atrial fibrillation - holiday heart
  - PVC, Ventricular tachycardia, ventricular fibrillation
- Hypertension

Facts regarding alcohol as a food source

- Alcohol has 7 cal/gram
- 86 proof spirits is 43% ethanol or 43 gram/100cc
- wine is 12% ethanol or 12 gram/100cc
- beer is 5% ethanol or 5 gram/100cc
- 12 oz bottle of beer is 360 cc or 18 gm = 126 calories
- 1.5 oz of whiskey is 45 cc or 19 gm = 133 calories
- 4 ounces or 120 cc of wine or 14 gm = 98 calories
- 1 pint of whiskey = 480 cc = 1450 calories

Is alcohol beneficial in coronary prevention?

The French Paradox

- Moderate amounts of alcohol are associated with decreased coronary event rates
  - increase in HDL-C
- Benefits may be offset by increased total mortality from
  - accidents, liver disease, strokes, and cancer

Case Congestive Heart Failure

61 y.o. man with HTN and a previous myocardial infarction is in CHF. His LVEF is 30% and there is no surgical or PCI option. Present treatment includes ACEi, digoxin, diuretics, ASA, and a beta blocker.

Despite appropriate drugs he is edematous and SOB with minimal activity.

What are the possible problems?
Solutions?

Nutrition complications in CHF

- In CHF, excess salt and water intake resulting in increasing intra-vascular volume and decrease myocardial contractility and output
- anorexia, malnutrition, muscle wasting

Nutrition and CHF

- Restrict salt intake
  - no added salt is about 2 gm Na^+ or 5 gm salt
  - use potassium chloride as a salt substitute
  - encourage potassium and magnesium food sources or supplements in patients on diuretics
- Fluid intake about 1cc per kcal or 1500-2000cc/ day
- in IV fluids administration
  - 1000 ml of 0.9N% NaCl contains 9 gm of NaCl

Micronutrient supplements, roots, and herbs and cardiovascular disease

- Anti-oxidants
  - evidence of benefit from enriched diets (decrease CV mortality, re-infarction, sudden death, strokes, but not for supplements of vit E, vit C, or beta carotene
  - Vitamin E has been shown to increase CHF and may reduce beneficial effect of niacin given to raise HDL-C
  - iron may be pro-atherogenic
- Marine omega-3 fatty acids are protective in CHD
- Vitamin D "appears" to be a CVD risk factors
- Green tea-polyphenols, dark chocolate-bioflavenoids

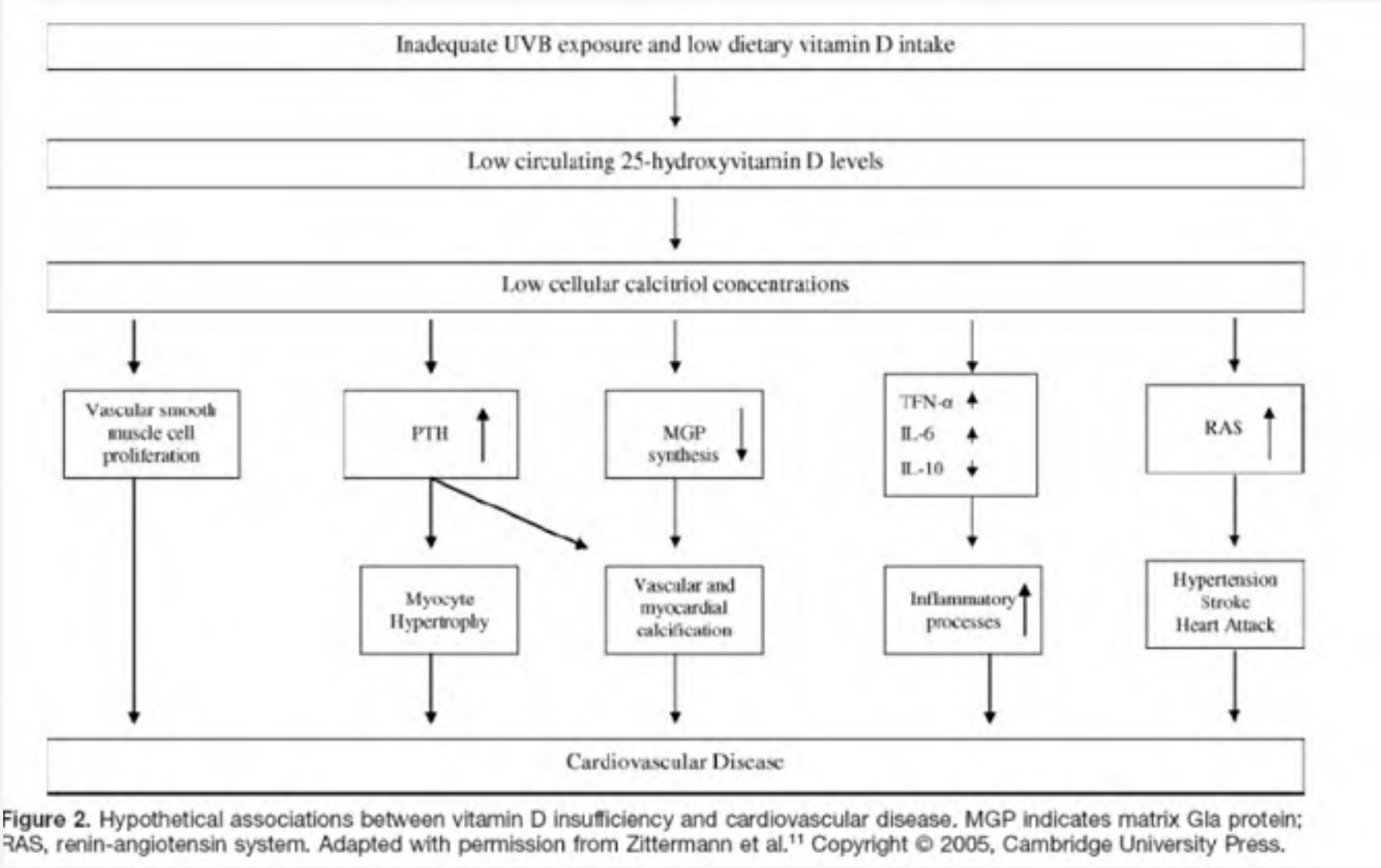


Figure 2. Hypothetical associations between vitamin D insufficiency and cardiovascular disease. MGP indicates matrix Gla protein; RAS, renin-angiotensin system. Adapted with permission from Zittermann et al.[11] Copyright © 2005, Cambridge University Press.

NCEP ATP III: Therapeutic Lifestyle Changes in LDL-Lowering Therapy

Major Features

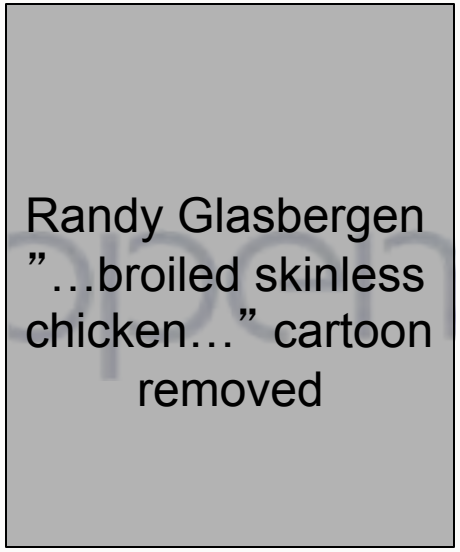
- **TLC Diet**
  - **Reduced intake of cholesterol-raising nutrients**
    - **Saturated fats <7% of total calories**
    - **Dietary cholesterol <200 mg per day**
  - **LDL-lowering therapeutic options**
    - **Plant stanols/sterols (2 g per day)**
    - **Viscous (soluble) fiber (10–25 g per day)**
- **Weight reduction**
- **Increased physical activity**

Typical American Diet and Cholesterol Lowering Diets

Constituent	Typical American Diet	Population	At Risk TLC
Total Fat	34 - 37%	≤ 30%	≤ 30% (25-35%)
Saturated Fat	12 - 14%	8 - 10%	< 7%
MUFA	14%	< 15%	< 20%
PUFA	7%	< 10%	< 10%
Vegetable Fat	40%		
Carbohydrate	46%	50 - 60%	50 - 60%
Protein	16%	15 - 20%	15 - 20%
Cholesterol	300 - 400 mg	< 300 mg	< 200 mg
Dietary Fiber	12 - 18 g	20 - 30 g	
high			
Fish	little	2X	2X
Calories	TO MAINTAIN HEALTHY WEIGHT		


Photograph of butter with a sign saying “89 gms fat” removed

Pizza – 12 gms fat
Taco – 11 gms fat
Fried Chicken – 17 gms fat
French Fries – 14 gms fat
Soda – 10 gms fat



Original image here: www.glasbergen.com

Types of Fat

- Saturated fatty acids
  - Trans-fatty acids
- Monounsaturated fatty acids (MUFA)
- Polyunsaturated fatty acids (PUFA)
  - Omega-6 fatty acids
  - Omega-3 fatty acids

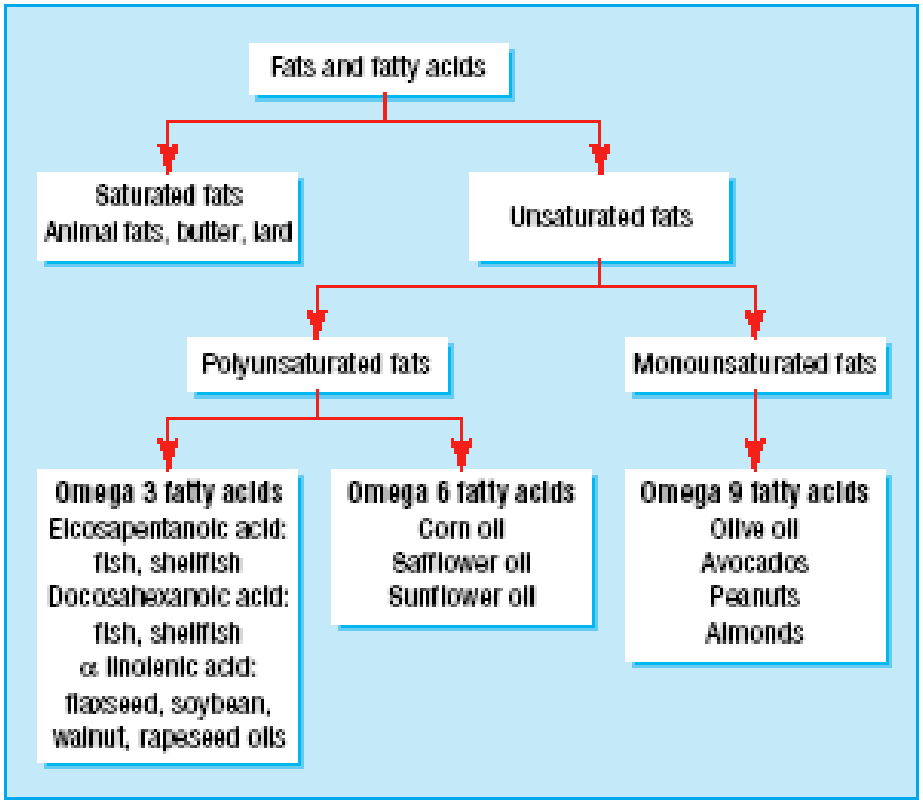


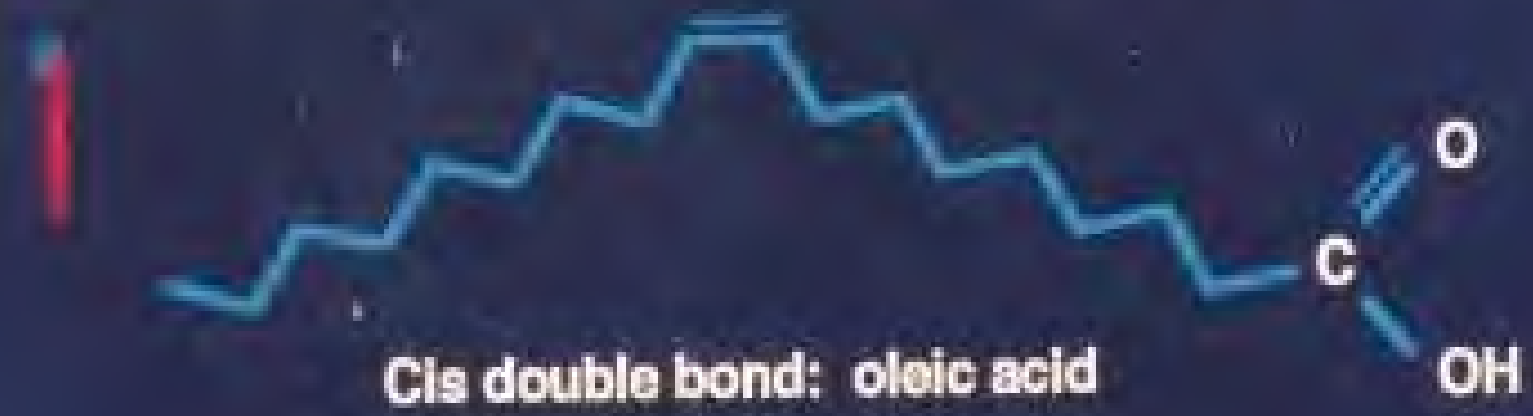
Fig 2 Fatty acids are saturated, monounsaturated, or polyunsaturated. Two types of polyunsaturated fatty acid exist—the omega 6 and the omega 3 fatty acids. The omega 6 fatty acids are available mainly from vegetable oils. Three types of omega 3 fatty acid exist: α linolenic acid is available from certain plants but eicosapentanoic acid and docosahexanoic acid must be obtained from marine sources

Saturated Fat

- Saturated fat is the most important food substance that raises serum cholesterol.
- Solid at room temperature.
- Animal derived with the exception of the “tropical” oils, i.e., coconut, palm, and palm kernel oil.
- Typical American diet: 12-14% of total calories from saturated fat.

Preventive Cardiology

Structure of Cis and Trans Fatty Acids



Cis double bond: oleic acid

Trans double bond: elaidic acid

BY-NC François @ Edito.qc.ca (flickr)

BY-SA Eric Kilby (flickr)

BY-NC chotda (flickr)

BY-NC chotda (flickr)

Substitute Lean Protein for Fatty Protein

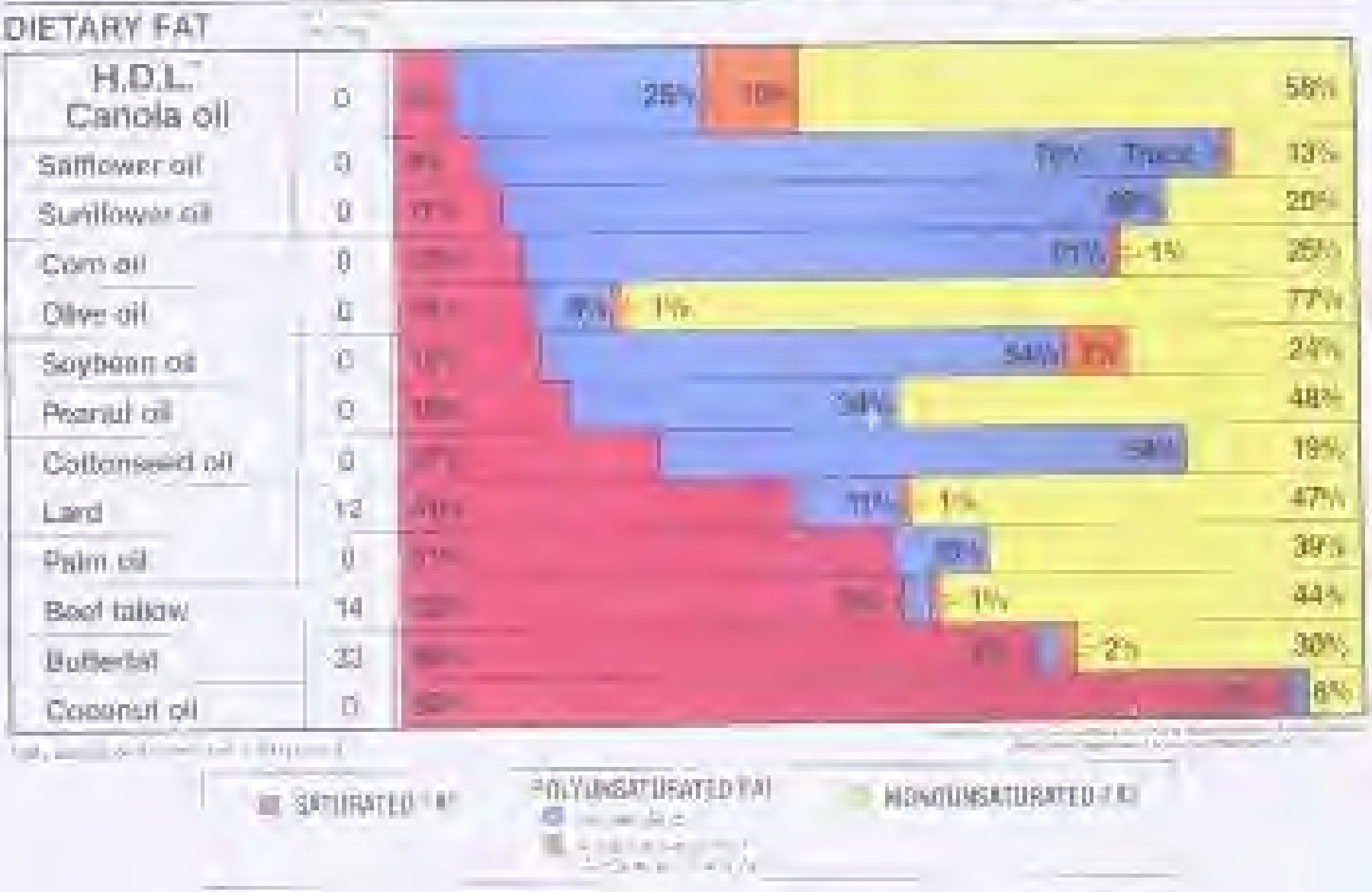
BY-NC-SA Dey (flickr)

BY-SA Boris Veldhuijzen van Zanten (flickr)

PD-INCL Source Undetermined

Switch to Nonfat Dairy

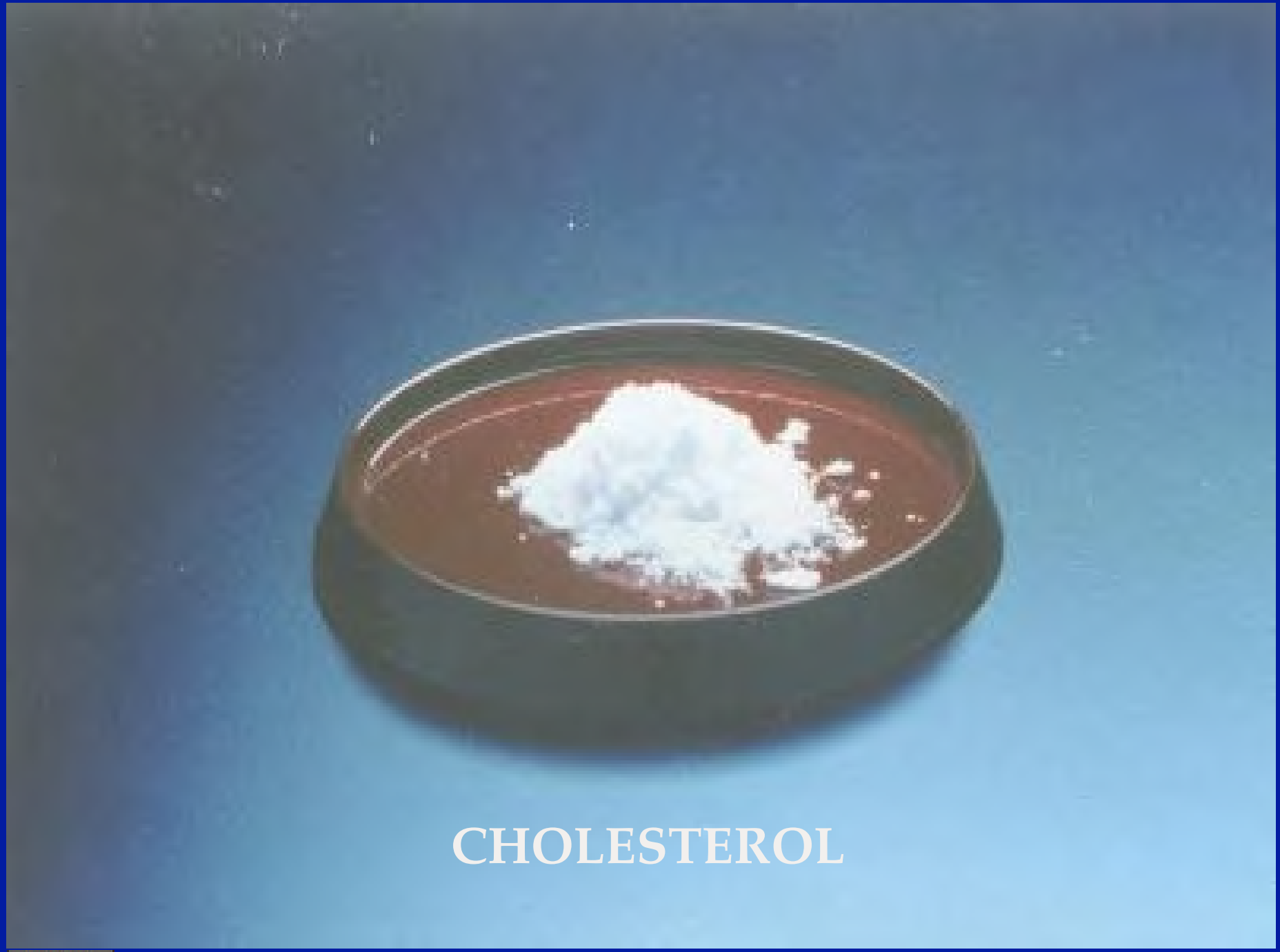
Comparison of Dietary Fats to Rykoff-Sexton H.D.L.™ Canola Oil



- Lowfat protein source
- Omega-3 fatty acids

Fish Oil Mechanism

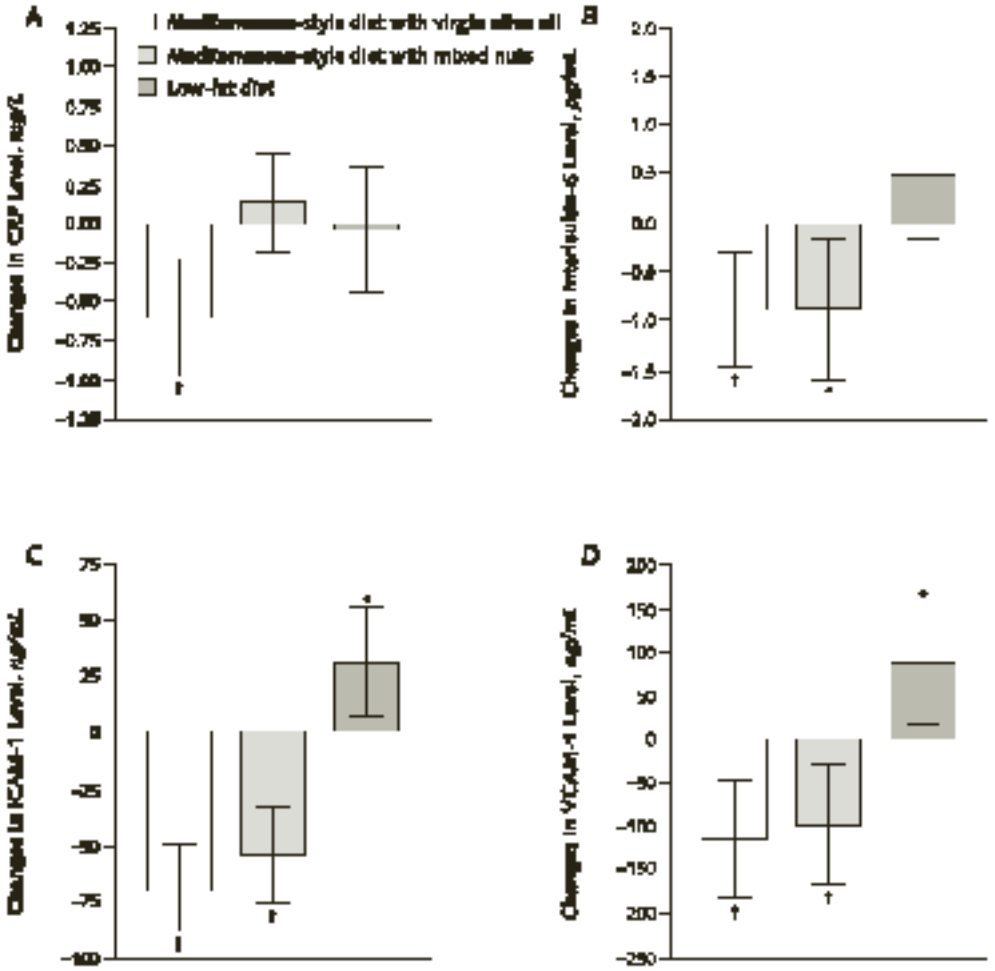
- Non lipid effects of EPA/DHA
  - Dose 850-1000mg
  - Improves endothelial cell function
  - Inhibits platelet aggregation
  - Lowers blood pressure
  - Anti-inflammatory (plaque stability?)
  - Reduces cardiac dysrhythmias
- Lipid effects-high doses (4gm)
  - Reduces triglycerides




Photograph of various foods with associated calories removed

Mediterranean vs Low Fat diet for 12 weeks in high risk adults

Figure 2. Changes from baseline in plasma concentrations of the inflammatory biomarkers in the 3 intervention groups.



A, Mean changes from baseline of C-reactive protein (*CRP*). B, Mean changes from baseline of interleukin-6. C, Mean changes from baseline of intercellular adhesion molecule-1 (*ICAM-1*). D, Mean changes from baseline of vascular cell adhesion molecule-1 (*VCAM-1*). The low-fat diet followed the guidelines of the American Heart Association. Error bars are 95% CIs. *$P < 0.018$ for difference from baseline by 2-tailed *t*-test. †$P < 0.003$ for difference from baseline by 2-tailed *t*-test.

- Similar wt loss and lowering of LDL-C
- >decrease sBP,dPB
- Greater decrease in FBS, insulin, trigs, chol/HDL
- Greater rise in HDL-C

Ann Intern Med. 2006;145:1-11.

Mediterranean Diet-fiber, fish, olive oil

PD-INCL Adapted from consumer reports 1994

See: Mediterranean Diet Pyramid

Mediterranean Diet-fiber, fish, olive oil

Soluble Fiber Sources

- Whole Grain Breads
- Flours
- Cereals
- Peas
- Beans
- Fruits
- Vegetables

Why Soluble Fiber?

- Meta-analysis of 67 clinical trials found various forms ↓LDL-C by 2.2 mg/dl per gram.
- No significant changes in HDL-C, TG
- Forms: pectins (apple), psyllium (Metamucil™), and oats, dried beans and peas, fruits, vegetables
- Dose: 10 - 25 g/day

(Brown, L et. al. Am J Clin Nutr 1999;69:30-42)

Soluble Fiber
Mechanism Of Action

- Fiber binds bile salts in the GI tract
- Cholesterol removed from serum for bile acid synthesis in an effort to restore bile acid pool
- Promotes synthesis of short chain fatty acids via fermentation in the colon. SCFA's inhibit hepatic cholesterol synthesis
- Tendency towards lower fat diets
- Reduces inflammatory cytokines

Plant Stanol Esters: The Evidence

- Over 20 published studies support stanol ester effects.
- Reduces cholesterol absorption.
- Cholesterol-lowering effect of plant stanols:
  - TC is lowered by up to 10%
  - LDL-C is lowered by up to 14%
  - HDL-C & TG are unaffected

Average 2000 Kcal Diet

CARBOHYDRATE*	PROTEIN*	FAT**
50 - 60% kcal	15 - 20% kcal	25 - 30 % kcal
250 - 300 g	75 - 100 g	55 - 67 g

- 2 cups of milk
- 3-4 fruits
- 6 ounces lean meat
- 11 ounces of starches
- 3-4 vegetables
- 6 teaspoons of fat

*** 4kcal/gm ** 9kcal/gm = dense calories**

Recommendations in a Nutshell

- Give advice on what to eat, not only what not to eat
- Stretch small amounts of lean meat over large amounts of vegetables
- Use vegetables and legumes as the main entree
- Choose non-fat dairy products
- Limit added fats and oils, emphasize olive oil, lecithin oil such as Pam™ for ‘frying pan’

Case: Primary Prevention

MS is a 24 y.o. medical resident whose father recently had an MI at age 49. PMH is unremarkable. No time for exercise. 'I eat most of my meals in the hospital cafeteria'

Height = 68 inches Weight = 190 lb

BMI = 29 kg/m^2 Waist = 40 inches

Chol 279, HDL-C 65, trigs 81, LDL-C 197mg/dl

Rx: 2500-2700 kcal for maintenance

2000-2200 kcal for weight loss

Resident--Initial 24 hour recall

2 strawberry toaster strudels with frosting

double café latte with skim milk

1 milky way

1 Wendy's Jr bacon cheeseburger

Biggie fries

Caesar side salad, 1/2 pkt dressing

medium coke

1 pita with lettuce, tomato, cheese and dressing

12 ounces hard cider

Resident
24 hour recall

2840 kilocalories

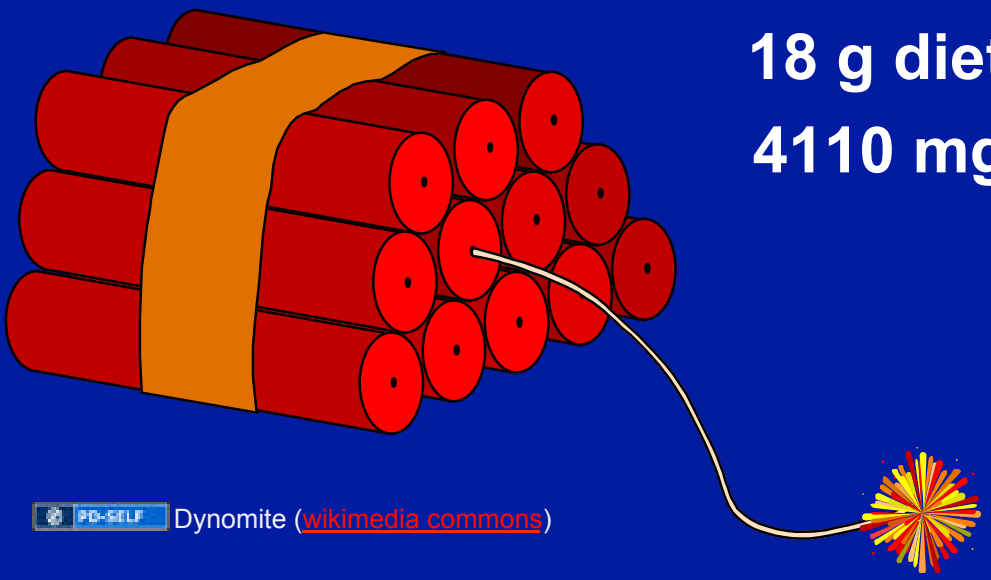
46% CHO 12% protein 38% fat 4% ETOH

12 % saturated fat

140 mg cholesterol

18 g dietary fiber

4110 mg sodium



PD-SELF Dynomite (wikimedia commons)

Resident--Heart Healthy

1 1/2 cups cheerios with skim milk

toast with 2T peanut butter

1 cup orange juice

cappuccino with skim milk

banana

Wendy's baked potato with small chili

Side Caesar salad with dressing

medium coke

pita with lettuce, cheese, turkey, mushrooms, tomato

olive oil dressing

hard cider and 1 1/2 oz peanuts

Resident
24 hour recall

2784 kilocalories

52% CHO 16% protein 28% fat

4% ETOH

6% saturated fat

105 mg cholesterol

44 g dietary fiber

4744 mg sodium

24 y.o. Resident

	9/30	10/23
TC	279	217
Triglycerides	81	103
HDL-C	65	49
LDL-C	197	147

Expected Outcome of Low Fat Diet on Lipids

- **LDL-C decrease**

AHA eating pattern	**3 to 15%**
Strict vegetarian	**35%**

- **Triglyceride**
  - **may increase 10-25%**
- **HDL-C**
  - **may decrease 5-15% with low SFA**

Case: Metabolic Syndrome

56 y. o. male S/P CABG, + GERD, smoking 1 1/2 PPD, eats daily in restaurants; not exercising; + FH

Weight = 212 lb

Height = 70 in

BMI = 30.4

Waist circa. = 43 in. W/H = 1.1

glucose 121, 146

I*nsulin = 19, 44*

56 y.o. male

	11/10
Total cholesterol	238
Triglycerides	327
HDL-C	28
LDL-C	145
weight	212
medicine	none

Identification of Metabolic Syndrome

Risk factor	Defining level
Waist circ.	
men	>40”
women	>35”
HDL-C	
men women	<40mg/dl <50mg/dl
Triglycerides	>100mg/dl
glucose	≥100mg/dl
BP	≥ 130/85mmHg or rx Htn

Metabolic Syndrome

Causes

- Acquired causes
  - Overweight and obesity
  - Physical inactivity
  - High carbohydrate diets (>60% of energy intake) in some persons
- Genetic causes

Metabolic Syndrome

Management of Overweight and Obesity

- Overweight and obesity: lifestyle risk factors
- Direct targets of intervention
- Weight reduction
  - Enhances LDL lowering
  - Reduces metabolic syndrome risk factors
  - Techniques of weight reduction

Life style causes of Elevated Triglycerides (≥150 mg/dl)

- Central obesity and overweight
- Physical inactivity
- Excess alcohol intake
- Excess simple carbs

Increase Preferred High Carbohydrate Foods-low glycemic index

Increase preferred high carbohydrate foods-low glycemic index

Eliminate the white foods

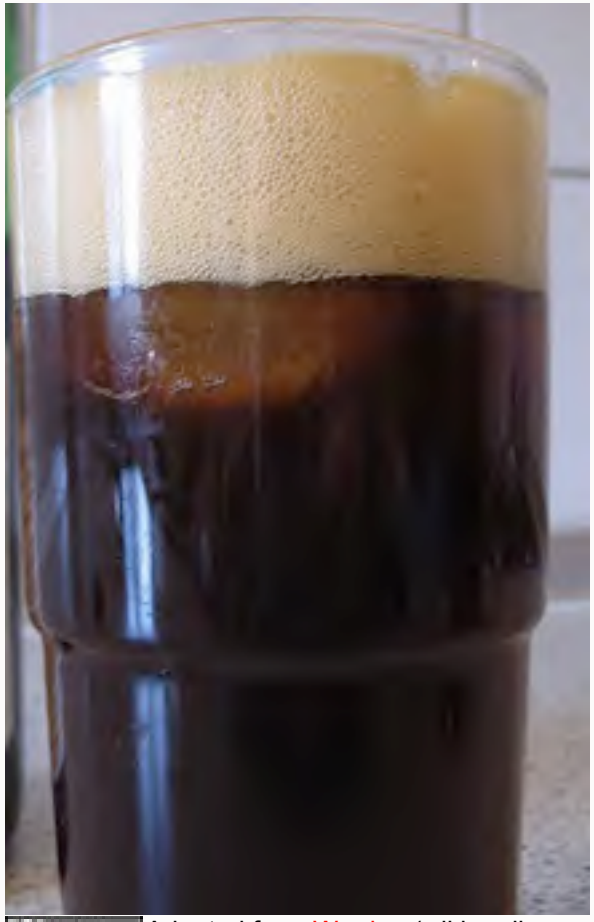
Original image here: www.glasbergen.com

Keep Intake of Unpreferred High Carbohydrate Foods to a Minimum

Keep Intake of high glycemic index carbohydrate foods to a minimum

BY-NC-SA SystemF92 (flickr)

BY-NC Peppysis (flickr)



BY-SA Adapted from Warden (wikimedia commons)

BY-NC-SA Bobby Chromik (flickr)

BY-NC mosabua (flickr)

Eliminating simple carbs and starches

- Avoid white potatoes, white rice and corn
- Avoid foods from processed flour
  - bread, cake, pasta
- Avoid sweet fruits
- Avoid excessive alcohol
- Avoid sweetened cereals

56 y.o. male

	11/10	12/21	3/28
Total cholesterol	238	189	163
Triglycerides	327	191	133
HDL-C	28	26	33
LDL-C	145	125	103
weight	212	201	188
medicine	none	none	Statin+ niaspan

Lifestyle Treatment for Hypertension

- Healthy weight maintenance
- Sodium restriction
- Alcohol restriction
- Exercise
- DASH diet


Photograph of
several varieties of
food removed

Points to remember

- Anorexia nervosa can cause fatal and non fatal heart disease
- Central obesity is associated with insulin resistance, multiple coronary risk factors and diabetes
- Alcohol increases HDL cholesterol and can both increase and decrease the risk of heart and vascular disease
- Optimal diet is high in soluble fiber (oats, barley, legumes), fruits, vegetables, micronutrients, fish, and lean meats
- Fish and fish oil can reduce coronary event rates by platelet inhibition and reducing sudden death

Points to remember

- Limiting salt intake to 5 to 6g/day is important in hypertension and congestive heart failure
- Saline used for intravenous fluids that is 0.9%N NaCl, has 0.9g/100ml or 9gm liter.
- Dietary saturated fat intake has the greatest nutritional influence on LDL cholesterol. Intake should be less than 7% of kcal in patients with vascular disease
- A high intake of simple sugars and refined starches are associated with increase in weight gain and triglycerides
- Supplemental Vitamin E has not been shown to reduce cardiovascular disease.

BY-NC François @ Edito.qc.ca (flickr)

BY-SA Eric Kilby (flickr)

BY-NC chotda (flickr)

BY-NC chotda (flickr)

Additional Source Information

for more information see: http://open.umich.edu/wiki/CitationPolicy

Slide 6: CC-BY-NC-ND, Francois @ Edito.qc.ca, http://www.flickr.com/photos/francois/, flickr, http://creativecommons.org/licenses/by-nc-nd/2.0/; CC-BY-SA, Eric Kilby, http://www.flickr.com/photos/ekilby/3261977842/in/set-72157600721493337/, flickr, http://creativecommons.org/licenses/by-sa/2.0/; CC-BY-NC-ND, chotda, http://www.flickr.com/photos/santos/55206748/, flickr, http://creativecommons.org/licenses/by-nc-nd/2.0/; CC-BY-NC-ND, chotda, http://www.flickr.com/photos/santos/71306090/, flickr, http://creativecommons.org/licenses/by-nc-nd/2.0/

Slide 11: Melvyn Rubenfire

Slide 13: Ashrafian, et al. Circulation 2008

Slide 14: Ashrafian, et al. Circulation 2008

Slide 22: Source Undetermined

Slide 24: Cambridge University Press

Slide 29: Original image here: http://www.glasbergen.com/?s=%22diet3%22

Slide 31: Source Undetermined

Slide 32: CC-BY-SA, Eric Kilby, http://www.flickr.com/photos/ekilby/3261977842/in/set-72157600721493337/, flickr, http://creativecommons.org/licenses/by-sa/2.0

Slide 34: Source Undetermined

Slide 35: CC-BY-NC-ND, Francois @ Edito.qc.ca, http://www.flickr.com/photos/francois/, flickr, http://creativecommons.org/licenses/by-nc-nd/2.0/; CC-BY-SA, Eric Kilby, http://www.flickr.com/photos/ekilby/3261977842/in/set-72157600721493337/, flickr, http://creativecommons.org/licenses/by-sa/2.0/; CC-BY-NC-ND, chotda, http://www.flickr.com/photos/santos/55206748/, flickr, http://creativecommons.org/licenses/by-nc-nd/2.0/; CC-BY-NC-ND, chotda, http://www.flickr.com/photos/santos/71306090/, flickr, http://creativecommons.org/licenses/by-nc-nd/2.0/

Slide 36: CC-BY-NC-SA, Dey, http://www.flickr.com/photos/dey/95133323/, flickr, http://creativecommons.org/licenses/by-nc-nd/2.0/; CC-BY-SA, Boris Veldhuijzen van Zanten, http://www.flickr.com/photos/thenextweb/2110700650/, flickr, http://creativecommons.org/licenses/by-sa/2.0/deed.en; Source Undetermined

Slide 37: CC BY NC, Sarah Consolacion, flickr, http://creativecommons.org/licenses/by-nc/2.0/deed.en; CC BY, Striatic, http://www.flickr.com/people/striatic/, flickr, http://creativecommons.org/licenses/by-nc/2.0/deed.en

Slide 38: Source Undetermined

Slide 39: CC BY SA, Marlith, Wikimedia Commons, http://commons.wikimedia.org/wiki/File:Salmon_Fish.JPG, http://creativecommons.org/licenses/by-sa/3.0/

Slide 41: Source Undetermined

Slide 43: *Ann Intern Med.* 2006;145:1-11.

Slide 44: Adapted from consumer reports 1994, http://geauga.osu.edu/fcs/mediterranen_pyramid.jpg

Slide 45: Mediterranean Diet Pyramid, http://www.usaswimming.org/USASWeb/_Rainbow/Documents/a61877c5-d884-402c-9856-ed896cb8a5ae/Mediterranean%20Diet%20pyramid.jpg

Slide 46: CC BY NC SA, Mismisimos, http://www.flickr.com/photos/mismisimos/2268591073/, flickr, http://creativecommons.org/licenses/by-nc-sa/2.0/deed.en; CC BY NC SA, Artnbarb, http://www.flickr.com/photos/artnbarb/3997522557/, flickr, http://creativecommons.org/licenses/by-nc-sa/2.0/deed.en

Slide 54: Dynomite, Wikimedia Commons, http://commons.wikimedia.org/wiki/File:Dynamite_clipart.jpg

Slide 65: CC BY NC, Computix, http://www.flickr.com/photos/computix/59405056/, flickr, http://creativecommons.org/licenses/by-nc/2.0/deed.en

Slide 66: CC BY NC, Dr.coop, http://www.flickr.com/photos/professorcooper/2055541900/, flickr, http://creativecommons.org/licenses/by-nc/2.0/deed.en; CC BY, Galileo55, http://www.flickr.com/photos/arrighi/4125954426/, flickr, http://creativecommons.org/licenses/by/2.0/deed.en; CC BY, Noil, http://www.flickr.com/photos/noil/3780830486/, flickr, http://creativecommons.org/licenses/by/2.0/deed.en

Slide 67: Original image here: http://www.glasbergen.com/?s=diet43

Slide 68: CC BY SA, Star5112, http://www.flickr.com/photos/johnjoh/405315293/, flickr, http://creativecommons.org/licenses/by-sa/2.0/deed.en; CC BY, Arnold | inuyaki, http://www.flickr.com/photos/arndog/40045502276/, flickr, http://creativecommons.org/licenses/by/2.0/deed.en; CC BY NC SA, Rosswebsdale, http://www.flickr.com/photos/rosswebsdale/2557964916/, flickr, http://creativecommons.org/licenses/by-nc-sa/2.0/deed.en

Slide 69: CC BY SA NC, SystemF92, http://www.flickr.com/photos/systemf/348575594/, flickr, http://creativecommons.org/licenses/by-nc-sa/2.0/deed.en; CC BY NC, Peppysis, http://www.flickr.com/photos/peppysis/2378441164/, flickr, http://creativecommons.org/licenses/by-nc/2.0/deed.en; CC BY NS SA, Bobby Chromik, http://www.flickr.com/photos/lawcrow911/3781515867/, flickr, http://creativecommons.org/licenses/by-nc-sa/2.0/deed.en; CC BY NC, mosabua, http://www.flickr.com/photos/mosabuam/4259505450/, flickr, http://creativecommons.org/licenses/by-nc/2.0/deed.en; CC BY SA, Warden, http://commons.wikimedia.org/wiki/File:Fernet-branca-coke.jpg, wikimedia commons, http://creativecommons.org/licenses/by-sa/3.0/

Slide 76: CC-BY-NC-ND, François @ Edito.qc.ca, http://www.flickr.com/photos/francois/, flickr, http://creativecommons.org/licenses/by-nc-nd/2.0/; CC-BY-SA, Eric Kilby, http://www.flickr.com/photos/ekilby/3261977842/in/set-72157600721493337/, flickr, http://creativecommons.org/licenses/by-sa/2.0/; CC-BY-NC-ND, chotda, http://www.flickr.com/photos/santos/55206748/, flickr, http://creativecommons.org/licenses/by-nc-nd/2.0/; CC-BY-NC-ND, chotda, http://www.flickr.com/photos/santos/71306090/, flickr, http://creativecommons.org/licenses/by-nc-nd/2.0/