

# ***Nutrition and Exercise in the***

Management  
of

Cardiovascular Disease



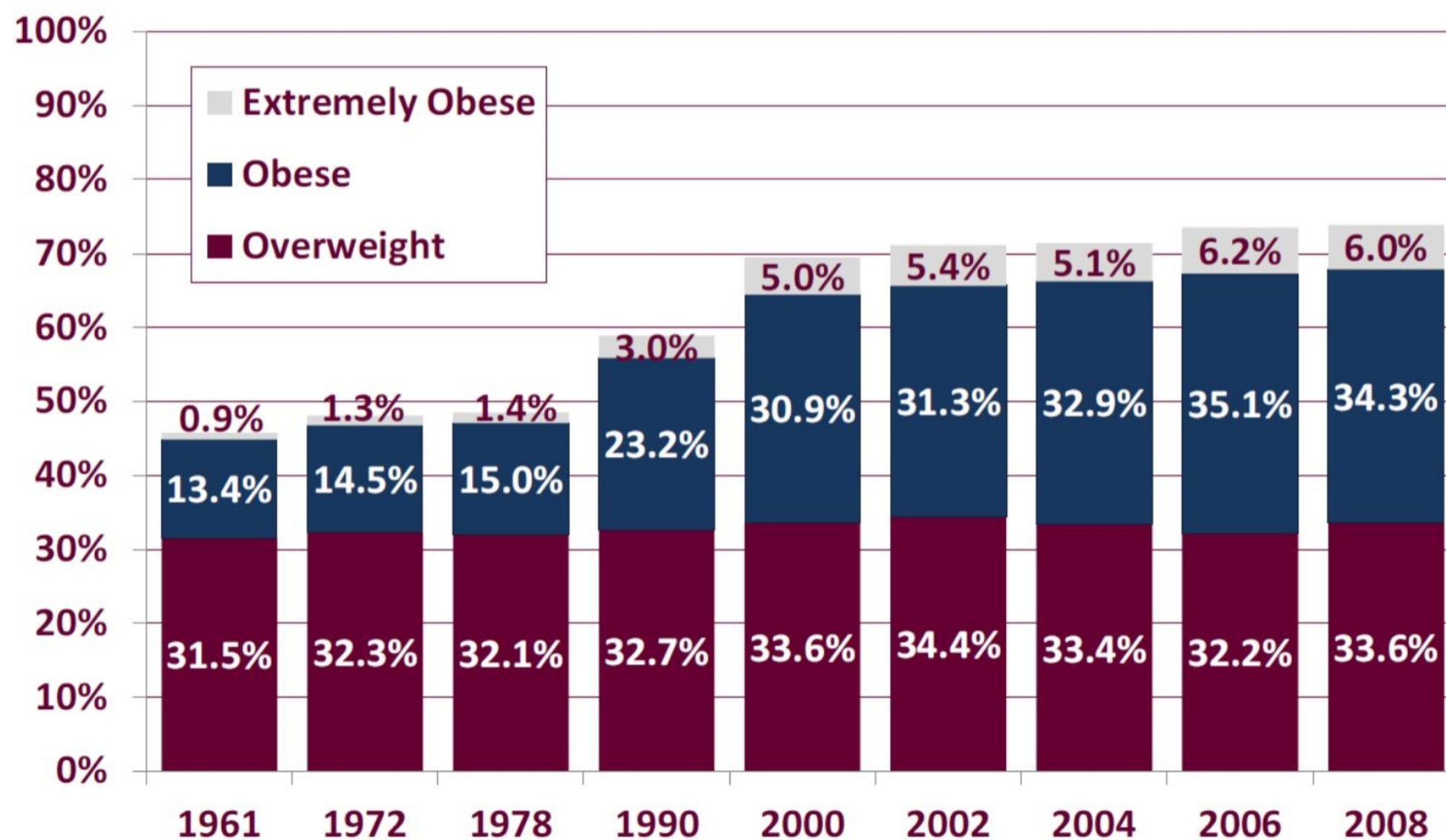
# **Diet** and **Inactivity** contribute to four of the top ten Leading Causes of Death

<b><i>Heart Disease</i></b>	710,760
<b><i>Cancer</i></b>	553,091
<b><i>Stroke</i></b>	167,661
Chronic lower respiratory ds	122,009
Accidents	97,900
<b><i>Diabetes</i></b>	69,301
Pneumonia and Influenza	65,313
Alzheimer's	49,558
Nephritis	37,251
Septicemia	31,224

National Center for Health Statistics, Centers for Disease Control and Prevention, U.S. Department of Health and Human Services. "Deaths, Percent of Total Deaths, and Death Rates for the 15 Leading Causes of Death in 5-Year Age Groups, by Race and Sex: United States, 2000." Hyattsville, MD: CDC, 2002.



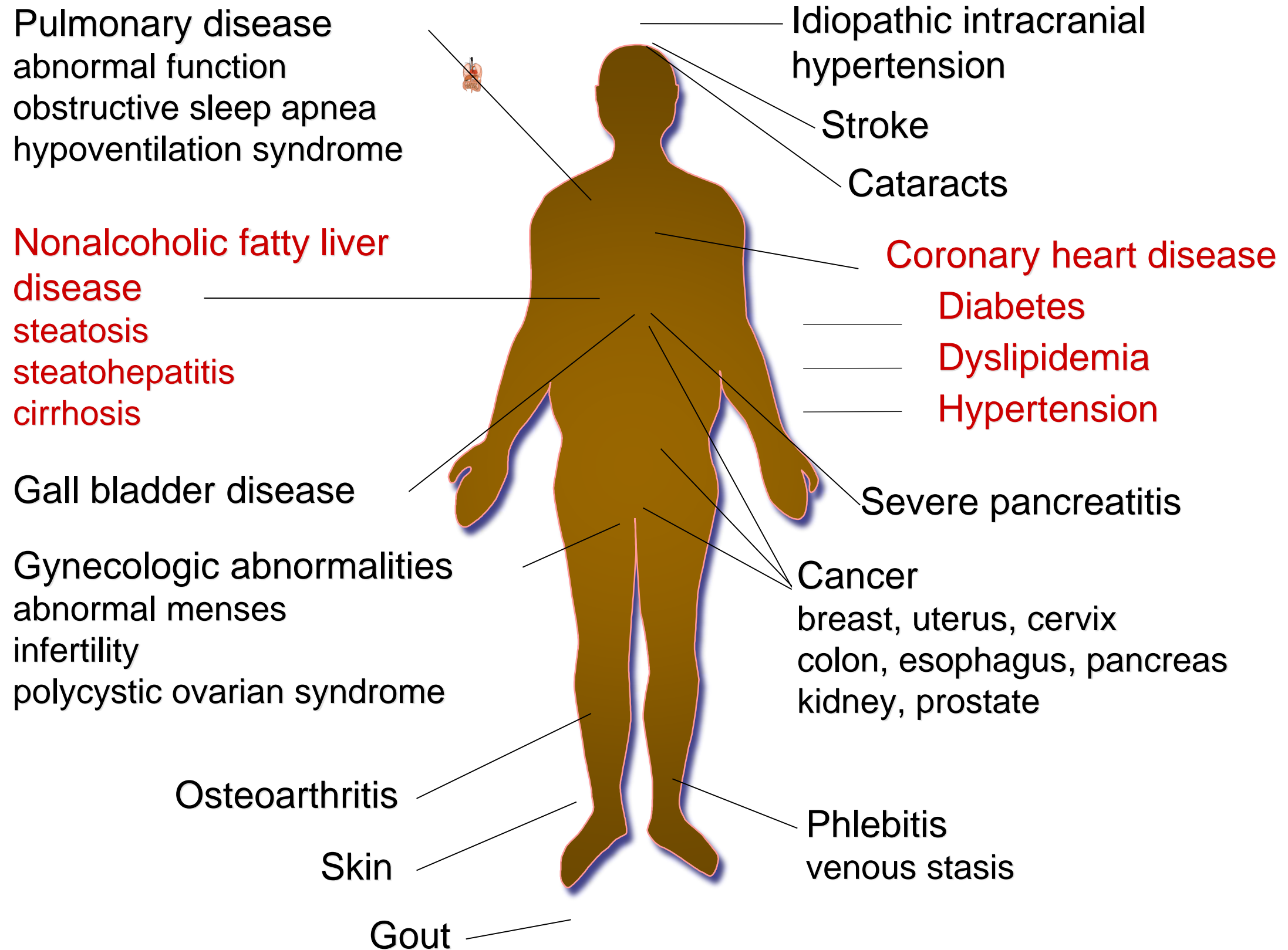
## The Rise in Obesity in the U.S. 1961-2008 (ages 20 and older)



Source: [http://www.cdc.gov/NCHS/data/hestat/obesity\\_adult\\_07\\_08/obesity\\_adult\\_07\\_08.pdf](http://www.cdc.gov/NCHS/data/hestat/obesity_adult_07_08/obesity_adult_07_08.pdf)



# Medical Complications of Obesity





## **Current investments** to Promote Healthy Eating and Physical Activity are **Insufficient**

- Funding for the [Division of Nutrition and Physical Activity](#) at CDC in FY15: \$47.6 million.
- [The Hershey Company spends 12 times that amount](#) to promote its chocolate and other products (\$562 million).
- Amount food companies spend on advertising each year: \$33 billion
- Amount the food industry spends on advertising and promotions to children each year: U[\\$1.8 billion](#)





[www.StrangeCosmos.com](http://www.StrangeCosmos.com)



# Changing Portion Sizes

1954  
Burger King



2.8 oz  
202 calories

2004



4.3 oz  
310 calories

1955  
McDonald's



2.4 oz  
210 calories

2004



7 oz  
610 calories

1900  
Hershey's



2 oz  
297 calories

2004



7 oz  
1,000 calories

1916  
Coca-Cola



6.5 fluid oz  
79 calories

2004



16 fluid oz  
194 calories

1950s  
Movie popcorn



3 cups  
174 calories

2004



21 cups (buttered)  
1,700 calories



# The 2015 to 2020 Dietary Guidelines for Americans

- 3 healthy eating patterns
- 1) the Healthy U.S.-style Eating Pattern
- 2) the Healthy Mediterranean-style Eating Pattern
- 3) the Healthy Vegetarian Eating Pattern



**SPECIAL FOCUS ISSUE: CARDIOVASCULAR HEALTH PROMOTION**

**THE PRESENT AND FUTURE: COUNCIL PERSPECTIVES**

# Trending Cardiovascular Nutrition Controversies



Andrew M. Freeman, MD,<sup>a</sup> Pamela B. Morris, MD,<sup>b</sup> Neal Barnard, MD,<sup>c</sup> Caldwell B. Esselstyn, MD,<sup>d</sup> Emilio Ros, MD, PhD,<sup>e</sup> Arthur Agatston, MD,<sup>f</sup> Stephen Devries, MD,<sup>g,h</sup> James O'Keefe, MD,<sup>i</sup> Michael Miller, MD,<sup>j</sup> Dean Ornish, MD,<sup>k</sup> Kim Williams, MD,<sup>l</sup> Penny Kris-Etherton, PhD<sup>m</sup>

## ABSTRACT

The potential cardiovascular benefits of several trending foods and dietary patterns are still incompletely understood, and nutritional science continues to evolve. However, in the meantime, a number of controversial dietary patterns, foods, and nutrients have received significant media exposure and are mired by hype. This review addresses some of the more popular foods and dietary patterns that are promoted for cardiovascular health to provide clinicians with accurate information for patient discussions in the clinical setting. (J Am Coll Cardiol 2017;69:1172-87)

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**TABLE 1 Clinical Recommendations for Specific Dietary Patterns, Foods, and Nutrients**

Nutrition/Food Item	Level of Evidence Available and Included in This Paper	Recommendations for Patients
Dietary pattern with added fats, fried food, eggs, organ and processed meats, and sugar-sweetened beverages ( <i>Southern</i> diet pattern)	Prospective studies	Avoid
Dietary cholesterol	RCTs and prospective studies along with meta-analyses	Limit
Canola oil	RCT meta-analyses show improvement in lipids but no prospective studies or RCTs for CVD outcomes	In moderation
Coconut oil	RCT meta-analyses and observational studies on adverse lipid effects. No prospective studies or RCTs for CVD outcomes	Avoid
Sunflower oil	No prospective studies or RCTs for CVD outcomes	In moderation
Olive oil	RCTs supporting improved CVD outcomes	In moderation
Palm oil	RCTs and observation studies showing worsened CVD outcomes	Avoid
Antioxidant-rich fruits and vegetables	RCTs and observational studies showing improved CVD outcomes and improvements in blood lipids	Frequent
Antioxidant supplements	RCTs and prospective and observational studies show potential harm	Avoid
Nuts	RCT and large prospective and meta-analysis studies showing improved CVD outcomes	In moderation
Green leafy vegetables	Large meta-analyses and variably sized observational studies as well as a large prospective study	Frequent
Protein from plant sources	Large observational and prospective studies	Frequent
Gluten-containing foods	Observational studies and RCTs	Avoid if sensitive or allergic

CVD = cardiovascular disease; RCT = randomized controlled trial.



- The Southern Pattern  
HIGH IN

- Added Fats
- Fried food
- Eggs
- Organ and processed meats
- Sugar- sweetened beverages,



- The Southern Pattern  
Associated with Higher Likelihood

- smoking
- higher mean body mass index (BMI)
- waist circumference
- higher prevalence of hypertension
- dyslipidemia
- type 2 diabetes mellitus (T2DM).



- The Southern Pattern <6 years of follow-up  
Associated With

















- 56% increase in acute CHD events
- 50% increase in mortality in patients with chronic kidney disease
- 30% increase in stroke

Shikany JM, Safford MM, Newby PK, et al. Southern dietary pattern is associated with ha



## CENTRAL ILLUSTRATION Evidence for Cardiovascular Health Impact of Foods Reviewed

### Summary of heart-harmful and heart-healthy foods/diets

 Evidence of harm; limit or avoid	 Inconclusive evidence; for harm or benefit	 Evidence of benefit; recommended
 <b>Coconut oil and palm oil</b> are high in saturated fatty acids and raise cholesterol	 <b>Sunflower oil and other liquid vegetable oils</b>	 <b>Extra-virgin olive oil</b> reduces some CVD outcomes when consumed in moderate quantities
 <b>Eggs</b> have a serum cholesterol-raising effect	 <b>High-dose antioxidant supplements</b>	 <b>Blueberries and strawberries</b> (>3 servings/week) induce protective antioxidants
 <b>Juicing</b> of fruits/vegetables with pulp removal increases caloric concentration*	 <b>Juicing</b> of fruits/vegetables without pulp removal*	 30 g serving of <b>nuts/day</b> . Portion control is necessary to avoid weight gain.†
 <b>Southern diets</b> (added fats and oils, fried foods, eggs, organ and processed meats, sugar-sweetened drinks)	 <b>Gluten-containing foods</b> (for people without gluten-related disease)	 <b>Green leafy vegetables</b> have significant cardio-protective properties when consumed daily
		 <b>Plant-based proteins</b> are significantly more heart-healthy compared to animal proteins

Freeman, A.M. *et al.* J Am Coll Cardiol. 2017;69(9):1172-87.

This figure summarizes the foods discussed in this paper that should be consumed often, and others that should be avoided from a cardiovascular health perspective. \*It is important to note that juicing becomes less of a benefit if calorie intake increases because of caloric concentration with pulp removal. †Moderate quantities are required to prevent caloric excess.

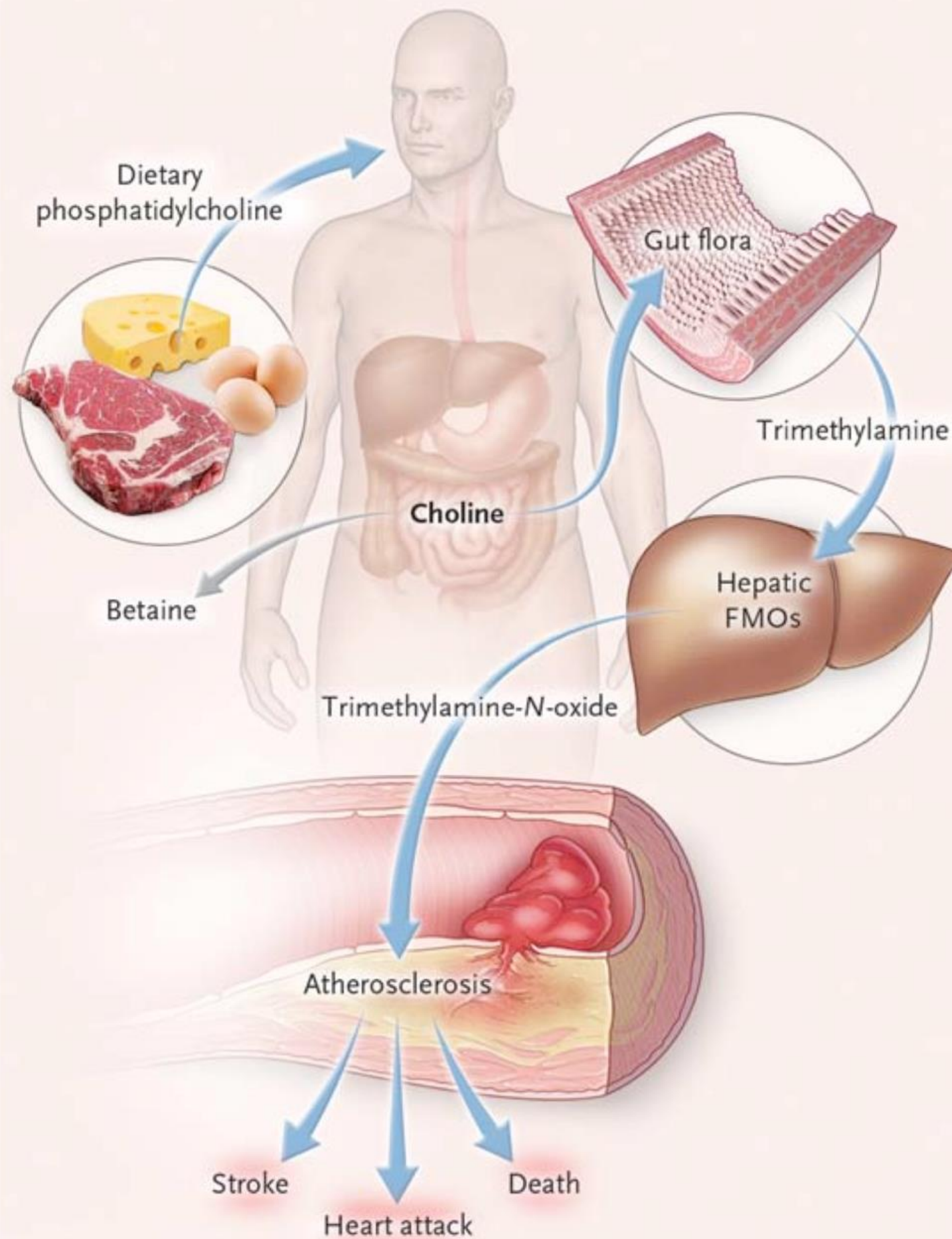


What About Eggs ?

What About Oil ?

What About Alcohol ?







ORIGINAL ARTICLE

# Intestinal Microbial Metabolism of Phosphatidylcholine and Cardiovascular Risk

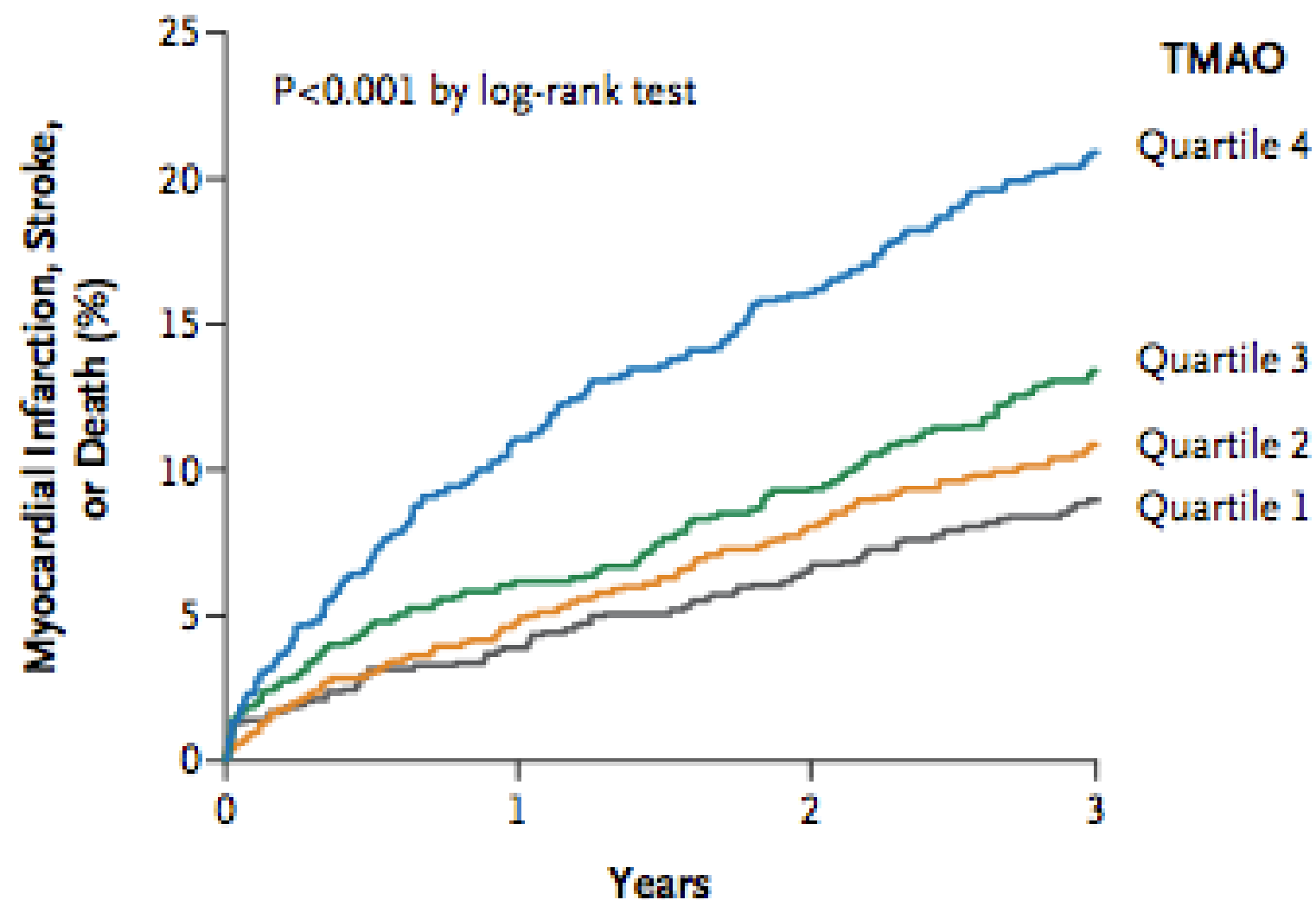
W.H. Wilson Tang, M.D., Zeneng Wang, Ph.D., Bruce S. Levison, Ph.D., Robert A. Koeth, B.S., Earl B. Britt, M.D., Xiaoming Fu, M.S., Yuping Wu, Ph.D., and Stanley L. Hazen, M.D., Ph.D.

April 25, 2013

VOL. 368 NO. 17

▶ [Audio Summary](#) ▼





**No. at Risk**

Quartile 1	1001	933	869	827
Quartile 2	998	940	884	843
Quartile 3	1003	938	888	835
Quartile 4	1005	913	849	791

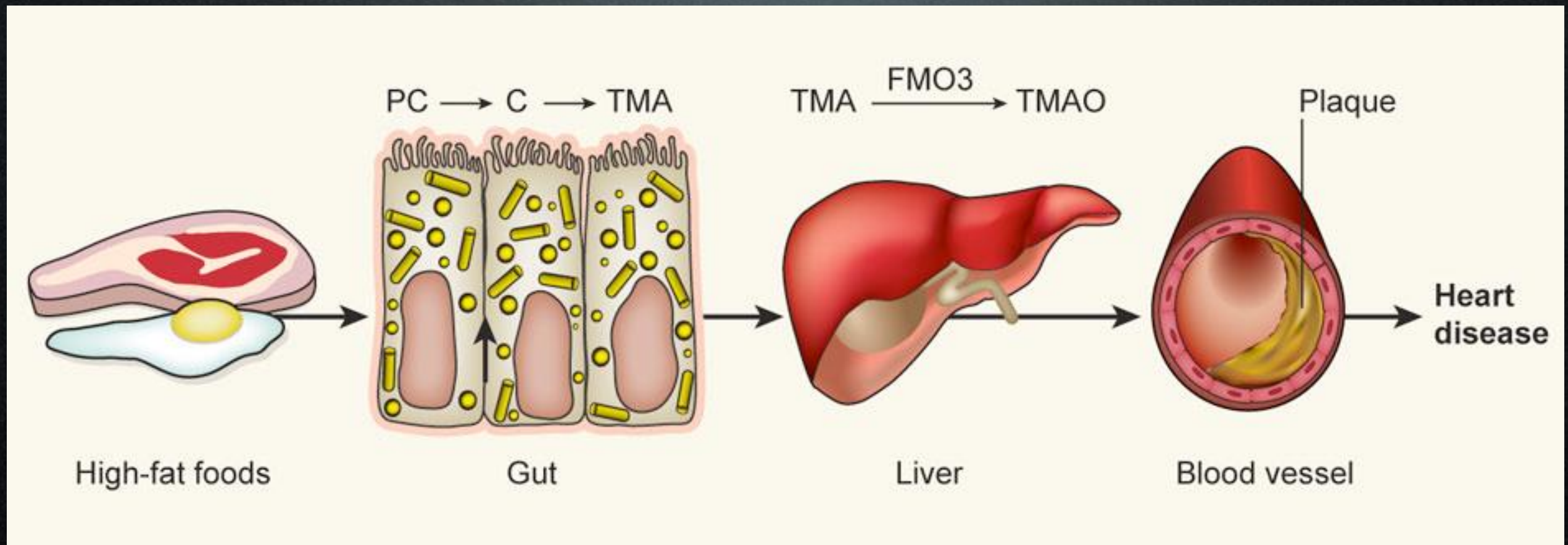
**Figure 2.** Kaplan–Meier Estimates of Major Adverse Cardiovascular Events, According to the Quartile of TMAO Level.

Data are shown for 4007 participants in the clinical-outcomes study. The P value is for all comparisons.



# PROBIOTICS & LECITHIN ? = CORONARY ATHEROSCLEROSIS

*L. paracasei* :) vs. *L. rhamnosus* :(



[7] Martin FP, Wang Y, Sprenger N, Yap IK, Lundstedt T, Lek P, Rezzi S, Ramadan Z, van Bladeren P, Fay LB, Kochhar S, Lindon JC, Holmes E, Nicholson JK. Probiotic modulation of symbiotic gut microbial-host metabolic interactions in a humanized microbiome mouse model. *Mol Syst Biol.* 2008;4:157. Epub 2008 Jan 15.





**Processed To Death –**  
Get These Cooking Oils Out of Your  
Pantry STAT!

FOODBABE.COM



# Avoid Oils

TO LOSE WEIGHT

? TO REVERSE VASCULAR DYS

IF YOU USE OILS

- Choose Organic Oils ( Avoid GMO's & Hexane Extraction )
- Extra Virgin Olive Oil - Papa Vince's Oil - cold pressed
- Extra Virgin Sesame Oil - low heat sautéing
- Nutiva Hemp Oil - cold applications, salads, dips, smoothies

Vani Hari



# Alcohol is classified as a Class 1 Carcinogen: World Cancer Research Fund

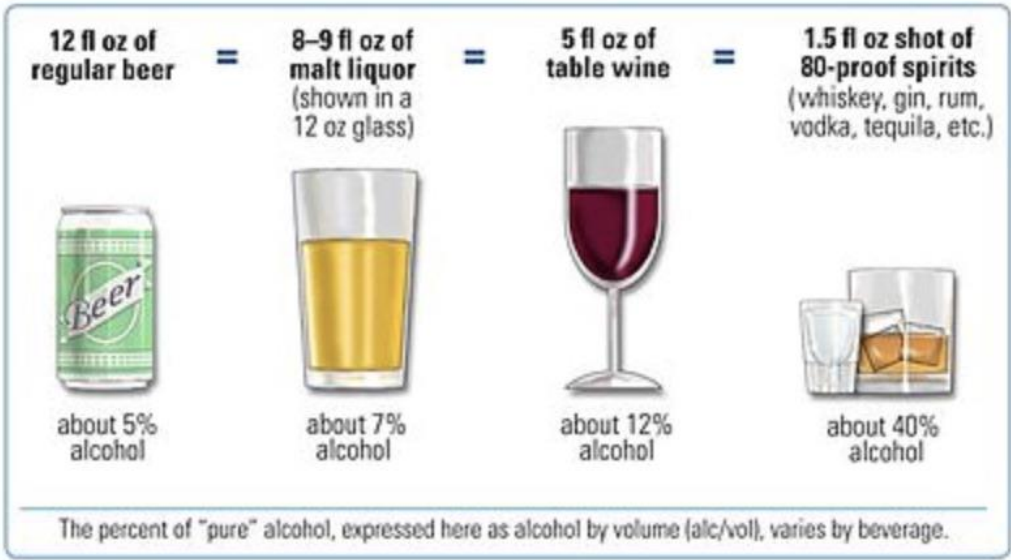
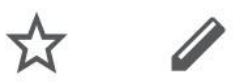
aim to limit consumption to less than two drinks a day for a man and less than one drink a day for a woman. The report defines a "drink" as containing about 10–15 grams of ethanol.



A large (250 ml) glass of 12% ABV red wine has about three units of alcohol. A medium (175 ml) glass has about two units.<sup>[Note 1]</sup>

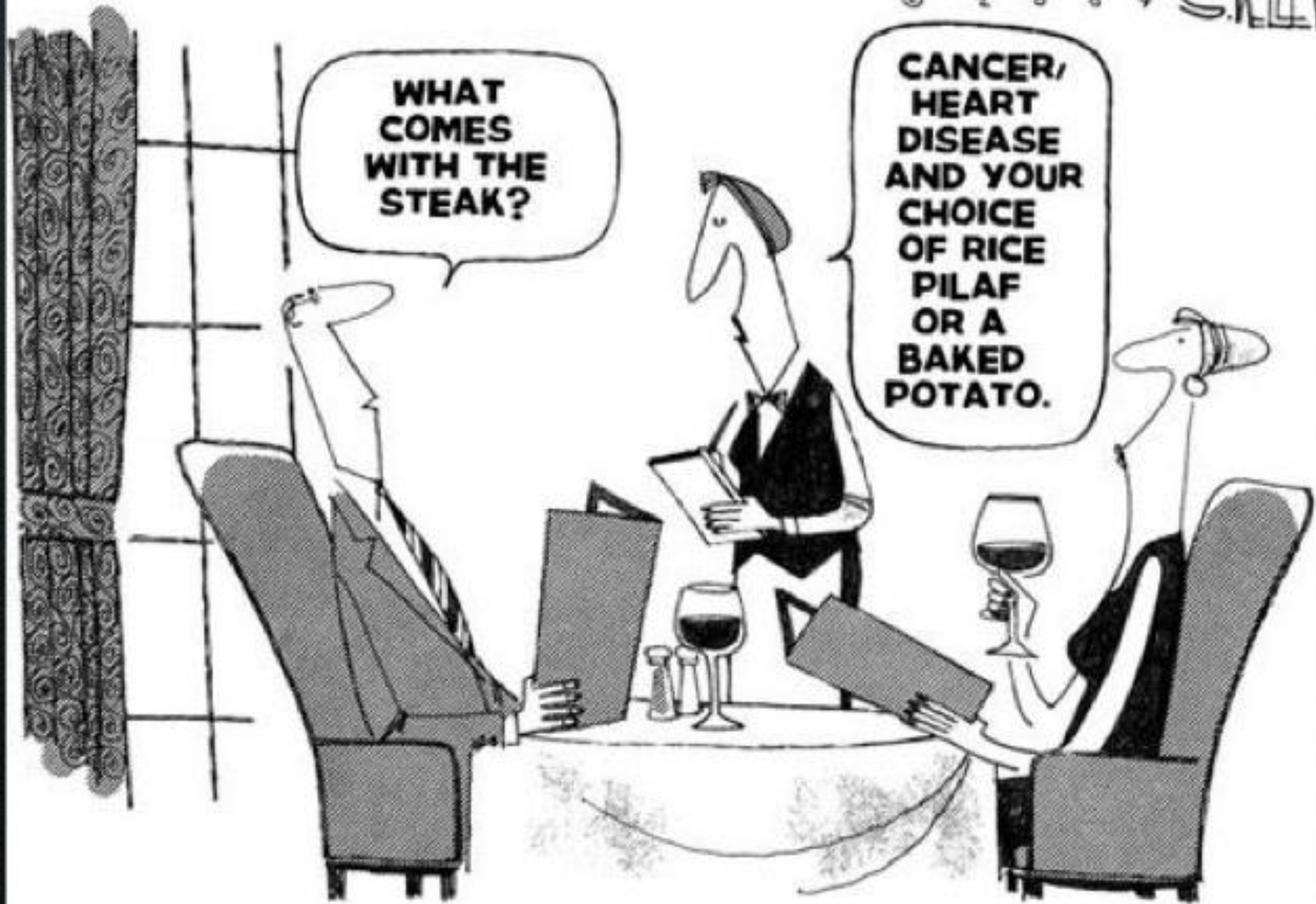
## Standard drink

✕A



United States standard drinks of beer, malt liquor, wine, and spirits compared.







# HOW MUCH PROTEIN

- Dr Carl Voit - German Physiologist (1831-1908 )
- Observation Study of Working Affluent Individuals ( Measured their protein intake )
- Voit Standard - 118 grams / day
- Other Studies based on Observation and Hypotheses of the Affluent ( 100 -189 grams/ day



Voit believed that people with sufficient income to choose the diet that they preferred would instinctively select a diet containing the amount of protein that they needed to remain healthy and productive. His estimate was that the average German workman doing moderate physical work chose to eat 118 g protein/d, and this became his standard

Atwater found that

American workmen were generally better off and ate more. They also, he thought, worked harder and he set his standard at 125 g/d

1. Voit, C. (1881) Physiologie des allgemeinen stoffwechsels und der Ernährung. In: Handbuch der Physiologie (Hermann, L., ed.), vol. 6, Pt. 1, pp. 1–575. Vogel, Leipzig, Germany.
2. Atwater, W. O. (1887) How food nourishes the body. Century Mag. 34: 237–251. Wilbur Atwater, born in 1844 in New England and by 1885, a professor of chemistry at Wesleyan University

## A Short History of Nutritional Science: Part 2 (1885–1912)

Kenneth J. Carpenter

Department of Nutritional Sciences, University of California, Berkeley, CA 94720–3104

American Society for Nutritional Sciences. J. Nutr. 133: 975–984, 2003.



# Average Adult Protein Intake Grams/Day

Atkins - type High Protein Diet	200 - 400 grams/ day
Typical Eskimo Diet	200 - 400
Voit Standard	118
Late 1800 Scientists	100 - 189
Typical Western Diet	100 - 160
USDA/WHO	33 -71
Typical Rural Asian Rice-based Diet	40 - 60
<b>Chittenden</b>	35 - 50
McDougall/ Esselstyn / Ornish / Fuhrman	30 - 80



# Protein per 3 ounce Serving

Salmon	23
Steak	23
Chicken	27



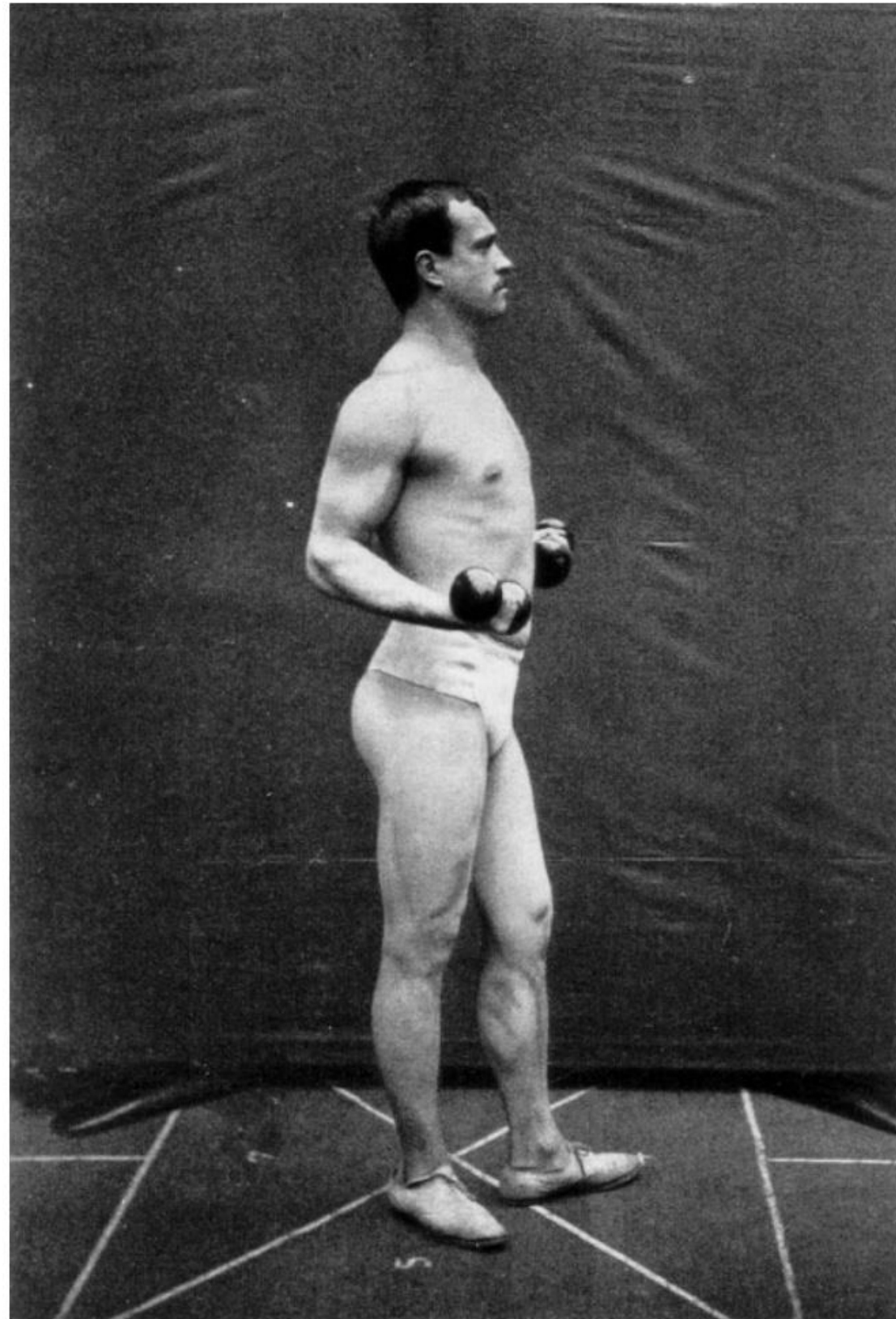
# HOW MUCH PROTEIN

( Prof Russell Henry Chittenden )

)

- Professor of Physiological Chemistry - Yale University
- Physiological Economy in Nutrition, with special reference to the minimal protein requirement of the healthy man, an experimental study. New York: Frederick A Stokes Company, 1904
- Concluded - 35 to 50 grams of protein/day allowed adults to maintain health and physical fitness





**FIGURE 1** A photograph used by Chittenden to demonstrate that his subjects remained in good physical condition while consuming a relatively low protein diet. Reproduced from (5).

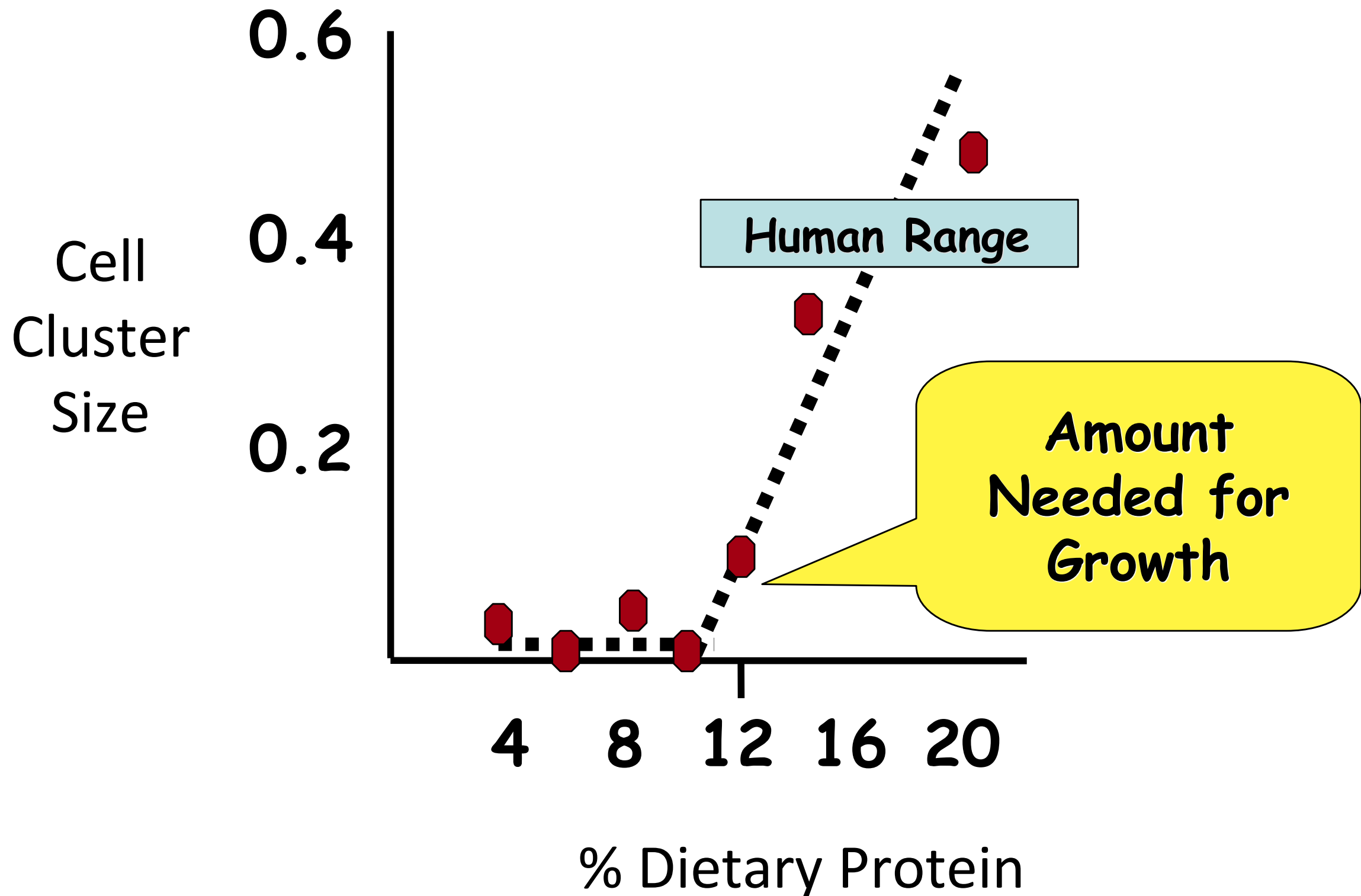


**Why Should We Be  
Concerned About  
Amount Of Protein ?**



# Dietary Protein and **EARLY** Cancer

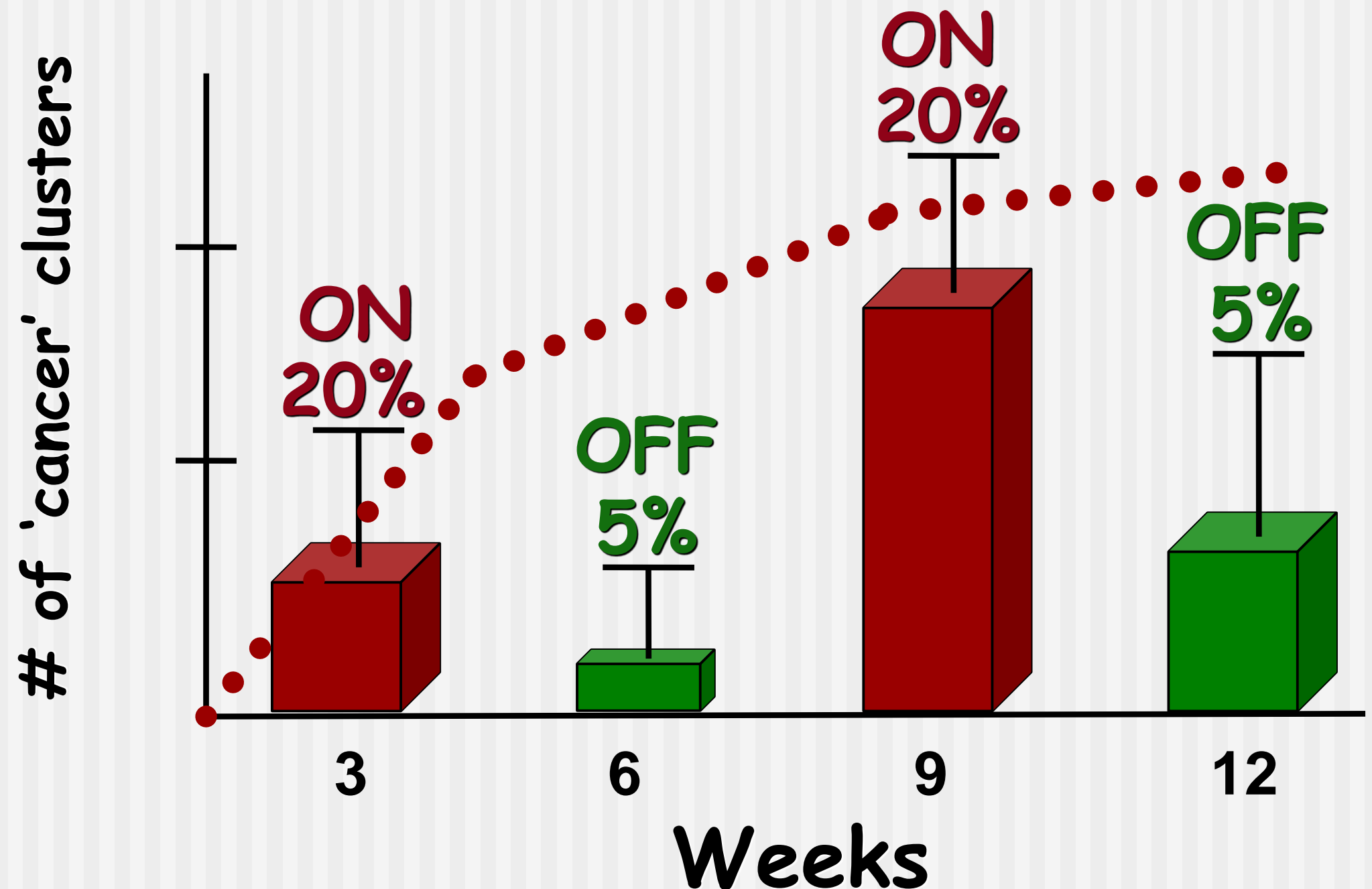
*(Dunaif and Campbell, J. Nutr. 1987)*





# Dietary Protein and **EARLY** Cancer

*(Youngman and Campbell, J. Nutr., 1991, Nutr. Cancer, 1992)*





# Dietary Protein and **LATE** Cancer

*(Youngman and Campbell, Carcinogenesis, 1992)*

Chemical effect = cancer **INITIATION**

Protein effect = cancer **GROWTH**

Protein, %		No. Animals	Tumor Severity*
5	all <b>living</b> at 100 wks.	60	248 <sup>a</sup>
20	all <b>dead</b> at 100 wks.	58	<b>3321<sup>c</sup></b>

*\* % incidence x tumor weight.*





# Associations of Dietary Protein with Disease and Mortality in a Prospective Study of Postmenopausal Women

- Some weight loss diets promote protein intake; however, the association of protein with disease is unclear. **In 1986, 29,017 postmenopausal Iowa women without cancer, coronary heart disease (CHD), or diabetes were followed prospectively for 15 years** for cancer incidence and mortality from CHD, cancer, and all causes.
- **CHD mortality was associated with red meats (risk ratio = 1.44, 95% CI: 1.06, 1.94) and dairy products (risk ratio = 1.41, 95% CI: 1.07, 1.86)** when substituted for servings per 1,000 kcal (4.2 MJ) of carbohydrate foods. Long-term adherence to high-protein diets, without discrimination toward protein source, may have potentially adverse health consequences.



# Low carbohydrate-high protein diet and incidence of cardiovascular diseases in Swedish women: prospective cohort study

BMJ 2012; 344 doi: <http://dx.doi.org/10.1136/bmj.e4026> (Published 26 June 2012)

Cite this as: BMJ 2012;344:e4026

- **Participants** From a random population sample, 43 396 Swedish women, aged 30-49 years at baseline, completed an extensive dietary questionnaire and were followed-up for an average of 15.7 years.
- **Conclusions** Low carbohydrate-high protein diets, used on a regular basis and without consideration of the nature of carbohydrates or the source of proteins, are **associated with increased risk of cardiovascular disease.**



# The Gladiator Diet

## Archeology

A publication of the Archaeological Institute of America  
Volume 61 Number 6, [November/December 2008](#)

Compared to the average inhabitant of Ephesus, gladiators ate more plants and very little animal protein. The vegetarian diet had nothing to do with poverty or animal rights.

The biggest revelation to come out of the Ephesus cemetery is what kept the gladiators alive--a vegetarian diet rich in carbohydrates, with the occasional calcium supplement.





**Vegetarian Diet and Muscle Mass**



**What About Soy ?**



We recommend that you use traditional soy foods, like soy milk and tofu, only as a small part of your diet, at most 5% of your daily calories. “Synthetic soy foods,” like meats, cheeses, and soy bars, should rarely, if ever, be consumed.

Examples of sensible uses might be:

Soy milk to moisten cereal, not glassfuls as a beverage

Tofu pieces in a “stir-fry” rice dish, not as a soy burger entrée

An occasional tofu-based dessert, not daily soy “candy” bars



# Adulterated Soy

- Defatted soy flour
- Organic textured soy flour
- Textured vegetable protein
- Isolated soy protein
- Soy protein concentrates
- Soy concentrates
- Partially Hydrogenated Soy



# Calcium Loss & Cancer Growth From Protein Concentrates

- Isolated Soy Protein - as damaging as meat protein to the bones

The American Journal of Clinical Nutrition, Apr. 2005  
vol. 81 no. 4, 916-922; Spence, et.al.

- 40 grams of isolated soy or cow-milk protein concentrate increases levels of Insulin-like Growth Factor 1 ( cancer-promoting growth hormone )  
IGF1

Journal of Clinical Endocrinology & Metabolism, March 1, 2003  
vol. 88 no. 3 1048-1054; Arjmandi et.al.

- One Soy Chicken Patty plus Two Soy Burger Patties = 40 grams of Isolated Protein



# Common Foods with Protein Isolates (**AVOID**)

Desserts & Snacks	Serving	Grams of Protein
Cliff Builder's Bar	1 Bar	20
Cliff Bar (Oatmeal,Raisin,Walnut)	1 Bar	10
Revival Soy Bars	1 Bar	17
Atkins Nutrition Bars	1 Bar	21
ZonePerfect Nutrition Bars	1 Bar	15
Revival Soy Shakes	1 Shake	20



# Common Foods with Protein Isolates (**AVOID**)

Meats	Serving	Grams of Protein
Morningstar Farms Sausage Patties	1 Patty	10
Boca Breakfast Links	1 Link	8
Gardenburger Chik'n Grill	1 Patty	13
Boca Burger Original	1 Burger	13
Boca Ground Burger	2 Ounces	13
Boca Chicken Patties	1 Patty	11
Smart Dogs	1 Dog	9
Boca Chili	1 Serving	20



# Common Foods with Protein Isolates (**AVOID**)

Cheeses	Serving	Grams of Protein
Veggie Shreds (Cheese)	2 Ounces	6
Boca Pizza	1 Slice	13



# Common Foods with Protein Isolates (**AVOID**)

Tofu with Added Isolates	Serving	Grams of Protein
Lite Tofu	3 Ounces	5



# Common Foods with Protein Isolates (**AVOID**)

Flour	Serving	Grams of Protein
Benesoy High Protein Soy Flour	1 Ounce	15



# ***Diet & Longevity***



# Getting to 100 candles

Centenarians reach that milestone because they're healthier, by virtue of genetics, common sense, or luck. In people with an average life span, diseases of old age strike earlier and last longer.

Person  
with  
average  
life span



Centenarian





# Eat What The Centenarians Eat

## The Blue Zones by Dan Buettner

They all have an active lifestyle

### ⑩ Sardinia

- ⑩ Red wine

- ⑩ Goat's milk and cheese

- ⑩ Plant based diet with small amounts of red meat

### ⑩ Loma Linda, CA- Seven Day Adventists

- ⑩ Nuts

- ⑩ "Vegetarian" with an early, light dinner

- ⑩ Drink plenty of water



## ⑩ Okinawa, Japan

- ⑩ hara hachi bu : stop eating when 80% full
- ⑩ Plant based diet with soy

## ⑩ Costa Rica

- ⑩ Hard water: calcium in the water
- ⑩ Largest meal in the morning
- ⑩ Lightly salted corn tortillas, beans and squash
- ⑩ Not much meat, some eggs



## ⑩ **Ikaria, Greece:** currently being researched

⑩ The Ikarian variation of the Mediterranean Diet is high in vegetables & beans, and low in meat & sugar; not much fish, but high in potatoes

⑩ Wild Greens

⑩ Herbal Teas

⑩ Goat's milk



# The Ideal Human Diet ( WFPB LifeStyle )

- Plant-based foods in forms as close to their natural state as possible (“whole” foods)
- Eat a variety of vegetables, fruits, raw nuts and seeds, beans and legumes, and whole grains
- Avoid heavily processed foods and animal products
- Stay away from added salt, oil, and sugar.
- Aim to get 80 percent of your calories from carbohydrates,
- Aim to get 10 percent of your calories from fat
- Aim to get 10 percent of your calories from protein
- Excerpt From - “Whole”, T. Colin Campbell & Howard Jacobson



# PROTEIN QUALITY

## (There is a MISCONCEPTION )

- Layette Mendel & Thomas Osborne — 1914 - Animal Protein is Superior to Plant Protein
- Protein requirements of Laboratory Rats; Animal vs Plant Sources
- Rats grew faster and larger - Animal sources
- Such studies led to designation of Meat, Milk, and Eggs as “Class A”; Plants as class “B”
- Vegetable sources were insufficient in amount of some amino acids required by Rats?



# PROTEIN QUALITY

## ( MISCONCEPTION )

- Dietary needs of Rats vs Humans is Quite different.
- Rats grow rapidly - Adult size in 6 months; Humans - Adult Size in 17 years
- Different Protein Requirements - Rat Breast Milk is 10 times higher in protein concentration than Human Breast Milk
- Dr. William Rose - University of Illinois - 1940's determined 10 amino acids essential for Rats.
- Dr. William Rose - 1942 - only 8 of the amino acids essential to Rats were essential to humans.



# Protein Quality

## ( Current Understanding )

- Whole Grains, Vegetables, Legumes and Nuts all contain essential and nonessential amino acids
- One does not have to consciously combine certain plant foods in meal ( “complementary proteins” )



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**“What fits your busy schedule better,  
exercising one hour a day or being  
dead 24 hours a day?”**



***The effect of physical activity on mortality and cardiovascular disease in 130 000 people from 17 high-income, middle-income, and low-income countries: the PURE study. Lancet: Dec 16, 2017; 390: 2643–54***

- Both recreational and non-recreational physical activity were associated with benefits.
- Non-recreational (Transportation, Housework, Occupational )



***The effect of physical activity on mortality and cardiovascular disease in 130 000 people from 17 high-income, middle-income, and low-income countries: the PURE study. Lancet: Dec 16, 2017; 390: 2643–54***

Prospective Urban Rural Epidemiology (“PURE”) study

## **Exercise and Physical Activity** **(< 150 min vs > 150 min )**

- Low physical activity (<600 metabolic equivalents [MET] × minutes per week or <150 minutes per week)
- Moderate intensity physical activity), moderate (600–3000 MET × minutes or 150–750 minutes per week)
- High physical activity (>3000 MET × minutes or >750 minutes per week)
- Higher physical activity was associated with lower risk of CVD and mortality in high-income, middle-income, and low-income countries

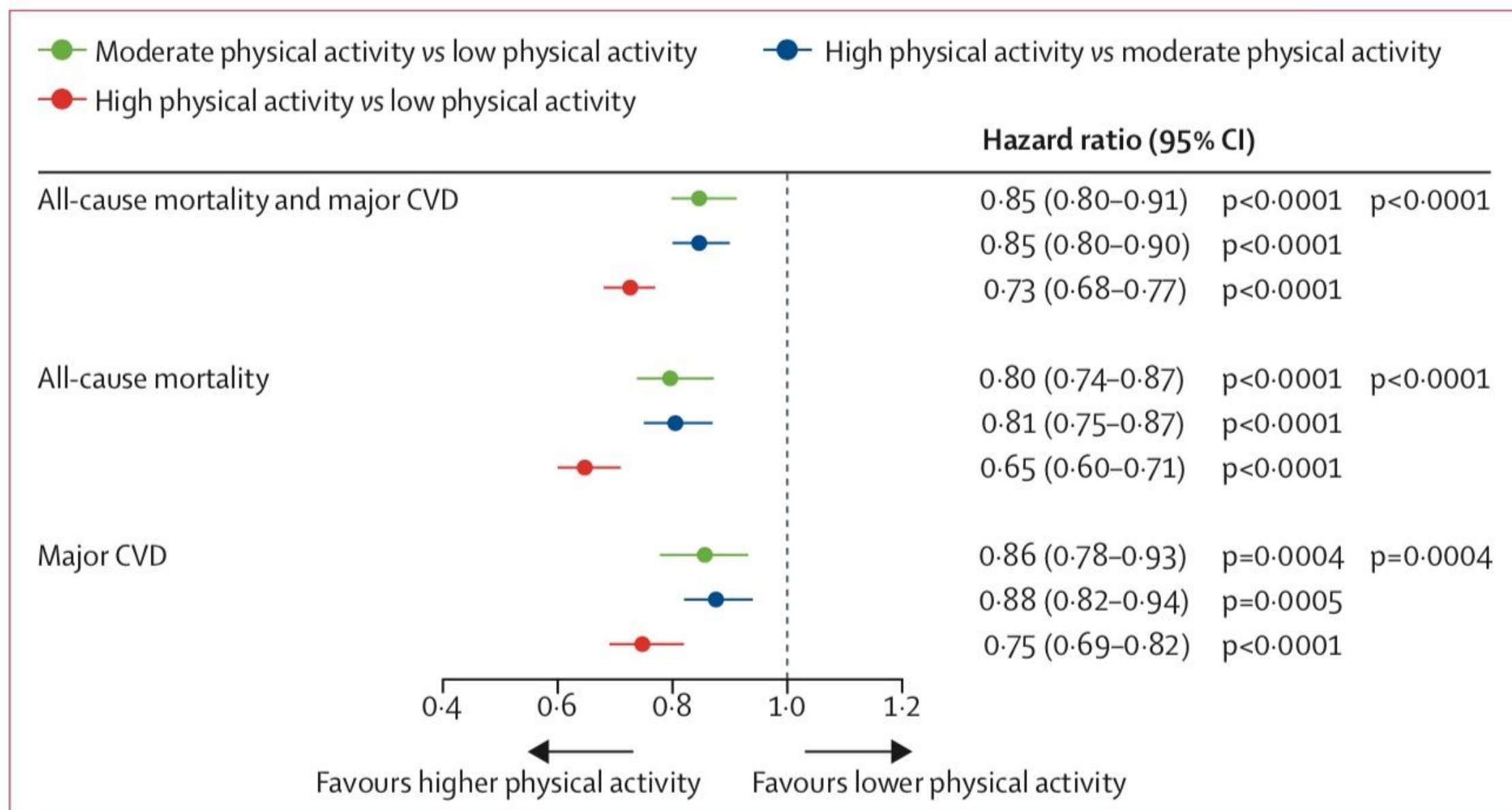


This table gives examples of light-, moderate-, and vigorous-intensity activity for healthy adults:

Light	Moderate	Vigorous
<3.0 METs	3.0–6.0 METs	>6.0 METs
<ul style="list-style-type: none"> <li>• Walking—slowly</li> <li>• Sitting—using computer</li> <li>• Standing—light work (cooking, washing dishes)</li> <li>• Fishing—sitting</li> <li>• Playing most instruments</li> </ul>	<ul style="list-style-type: none"> <li>• Walking—very brisk (4 mph)</li> <li>• Cleaning—heavy (washing windows, vacuuming, mopping)</li> <li>• Mowing lawn (walking power mower)</li> <li>• Bicycling—light effort (10–12 mph)</li> <li>• Badminton—recreational</li> <li>• Tennis—doubles</li> </ul>	<ul style="list-style-type: none"> <li>• Walking/hiking</li> <li>• Jogging at 6 mph</li> <li>• Shoveling</li> <li>• Carrying heavy loads</li> <li>• Bicycling fast (14–16 mph)</li> <li>• Basketball game</li> <li>• Soccer game</li> <li>• Tennis—singles</li> </ul>

*\*METs are metabolic equivalents. One MET is defined as the energy it takes to sit quietly. These MET estimates are for healthy adults.*

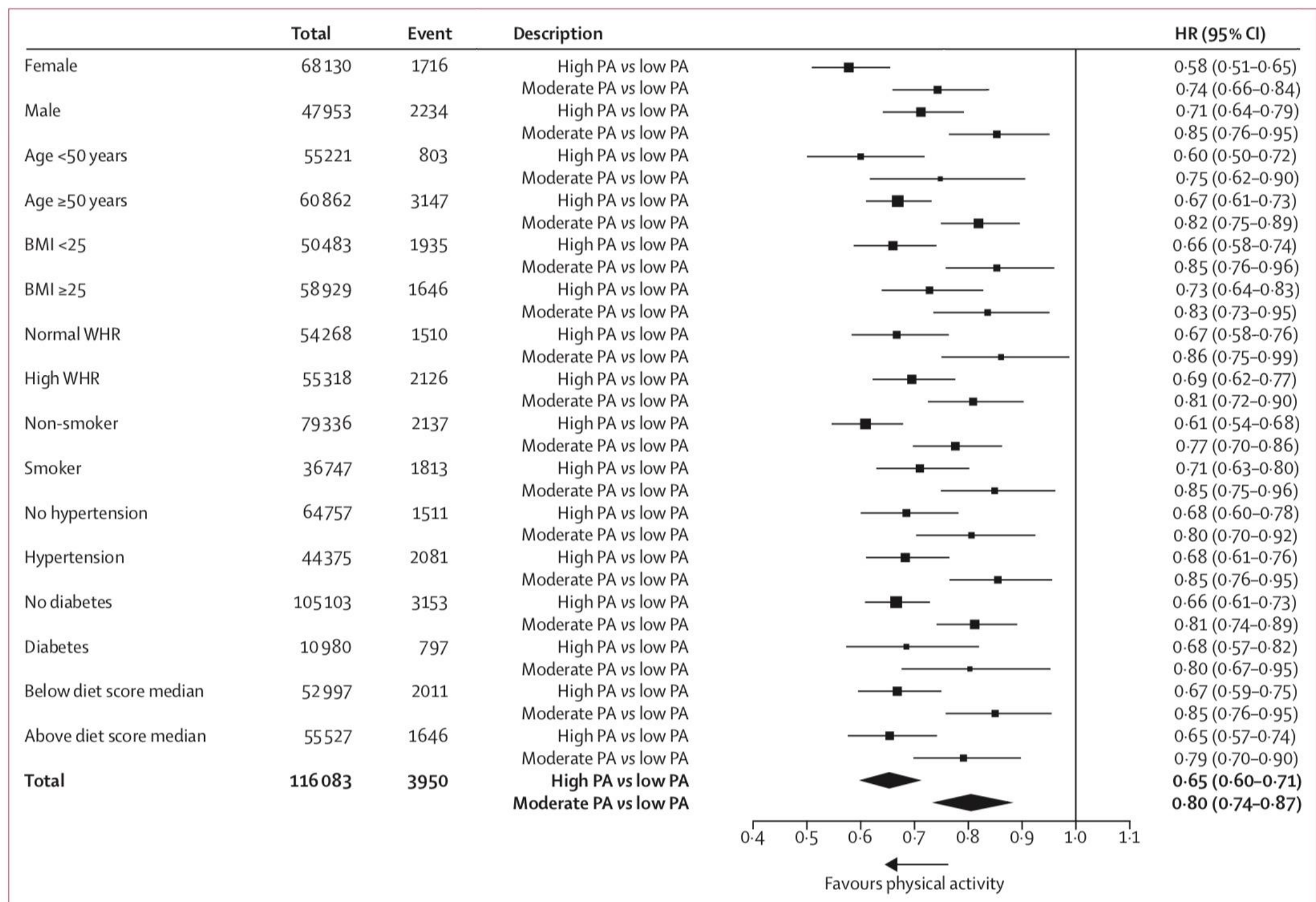




**Figure 1: Hazard ratios and 95% CI for all-cause mortality and major CVD, all-cause mortality, or major CVD by level of physical activity**

Data adjusted for age, sex, education, country income level, urban or rural residency, family history of CVD, and smoking status; taking into account household, community, and country clustering. There were 3155 events for all-cause mortality and major CVD, 2041 events for all-cause mortality, and 1723 events for major CVD. The p values of the first column show the significance of each comparison. p values of the second column show the significance of the overall effect of physical activity. Low physical activity= $\leq 600$  MET  $\times$  min per week. Moderate physical activity=600–3000 MET  $\times$  min per week. High physical activity= $\geq 3000$  MET  $\times$  min per week. CVD=cardiovascular disease. Major CVD=CVD mortality plus incident myocardial infarction, stroke, or heart failure. MET=metabolic equivalents.





**Figure 2: Hazard ratios and 95% CI of total physical activity for mortality**

Adjusted for age, sex, education, country income level, urban or rural residency, family history of cardiovascular disease, and smoking status taking into account household, community, and country clustering. Based on data for 115 436 participants with complete data. Low physical activity (<600 MET × min per week) is the reference group. Moderate physical activity=600–3000 MET × min per week. High physical activity=≥3000 MET × min per week. PA=physical activity. HR=hazard ratio. MET=metabolic equivalents. BMI=body-mass index. WHR=waist-to-hip ratio (high WHR was defined as above 0.85 for women and girls and above 0.9 for men and boys).



# Various Intensities of Leisure Time Physical Activity in Patients With Coronary Artery Disease: Effects on Cardiorespiratory Fitness and Progression of Coronary Atherosclerotic Lesions

Rainer Hambrecht MD, Josef Niebauer MD, Christian Marburger MD, Martin Grunze MD, Barbara Kälberer RN, Klaus Hauer, Günter Schli-  
erf MD, Wolfgang Kübler MD, FACC, Gerhard Schuler MD. JACC [Volume 22, Issue 2](#), August 1993, Pages 468-477



# Various Intensities of Leisure Time Physical Activity in Patients With Coronary Artery Disease: Effects on Cardiorespiratory Fitness and Progression of Coronary Atherosclerotic Lesions

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- Patients undergoing cardiac catheterization were prospectively randomized
- intervention group (n = 29) participating in regular physical exercise
- control group (n = 33) receiving usual care
- Energy expenditure in leisure time physical activity was estimated from standardized questionnaires and from participation in group exercise sessions.
- After 12 months of participation, repeat coronary angiography was performed; coronary lesions were measured by digital image processing.
- Intervention Group - 15% Protein, 65% Carbohydrate , 20% Fat



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	Intervention Group	Control Group	Kcal/week
Regression	28%	6%	> 2000
No Change	62%	49%	> 1500
Progression	10%	41%	< 1200
Improved Cardiorespiratory Fitness			> 1400



# Potential Adverse Cardiovascular Effects From Excessive Endurance Exercise.

MayoClinProc.2012;87(6):587-595

James H. O'Keefe, MD; Harshal R. Patil, MD; Carl J. Lavie, MD; Anthony Magalski, MD; Robert A. Vogel, MD; and Peter A. McCullough, MD, MPH

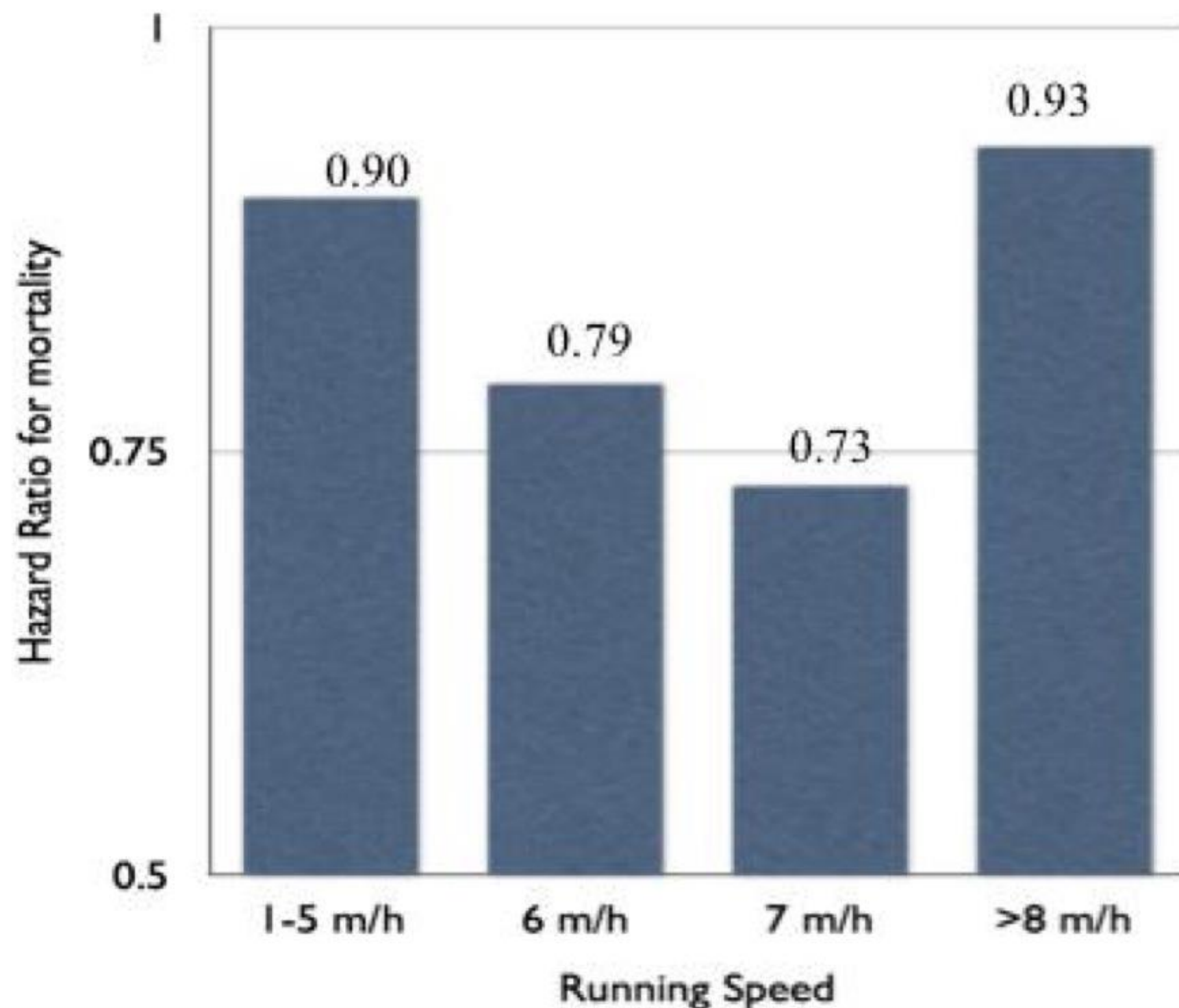
- People who exercise regularly have markedly lower rates of disability and a mean life expectancy that is 7 years longer than that of their physically inactive contemporaries. However, a safe upper-dose limit potentially exists, beyond which the adverse effects of exercise may outweigh its benefits.
- Chronic intense and sustained exercise can cause patchy myocardial fibrosis, particularly in the atria, interventricular septum, and right ventricle, creating a substrate for atrial and ventricular arrhythmias.
- Chronic excessive sustained exercise may also be associated with coronary artery calcification, diastolic dysfunction, and large-artery wall stiffening.
- Veteran endurance athletes in sports such as marathon or ultramarathon running or professional cycling have been noted to have a 5-fold increase in the prevalence of atrial fibrillation.
- Intense endurance exercise efforts often cause elevation in biomarkers of myocardial injury (troponin and B-type natriuretic peptide), which were correlated with transient reductions in right ventricular ejection fraction.



**Figure 2**

Relationship between running speed and mortality.<sup>10</sup>

### U-Shaped Curve: Mortality and Running Speed





# *The effect of physical activity or exercise on key biomarkers in atherosclerosis—a systematic review.*

Palmefors H, DuttaRoy S, Rundqvist B, Börjesson M. Atherosclerosis 2014;235:150–61.

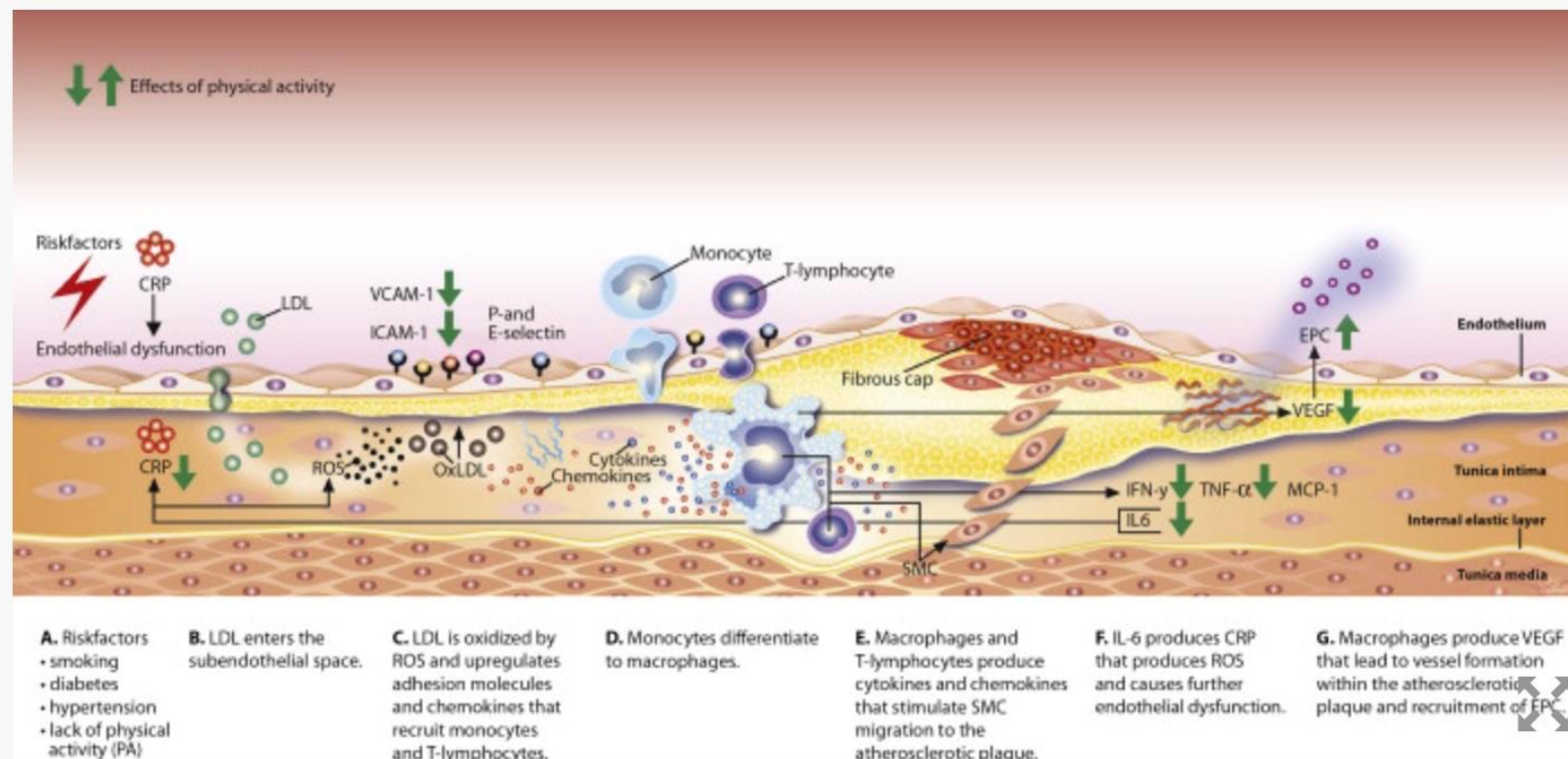


Fig. 2

An overview over the effect of physical activity/exercise on key factors in the atherosclerotic process. The green arrows show the effect of physical activity/exercise (CRP = C-reactive protein, LDL = low density lipoprotein, OxLDL = oxidized LDL, ROS = reactive oxygen species, VCAM-1 = vascular cell adhesion molecule-1, ICAM-1 = intracellular adhesion molecule-1, MCP-1 = monocyte chemoattractant protein-1, IFN- $\gamma$  = interferon- $\gamma$ , TNF- $\alpha$  = tumor necrosis factor- $\alpha$ , IL-6 = interleukin-6, EPC = endothelial progenitor cell, VEGF = vascular endothelial growth factor).



# ***The effect of physical activity or exercise on key biomarkers in atherosclerosis—a systematic review.***

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- **PA decreases the cytokines, tumor necrosis factor- $\alpha$  (TNF- $\alpha$ ), interleukin-6 (IL-6), and interferon- $\gamma$  (IFN- $\gamma$ ) (high, moderate and low evidence, respectively).**
- The effect of PA on chemokines; stromal derived factor-1 (SDF-1), interleukin-8 (IL-8) (insufficient evidence)
- Monocyte chemoattractant protein-1 (MCP-1) (low evidence) was inconclusive.
- **Aerobic exercise decreased the adhesion molecules, vascular cell adhesion molecule-1 (V-1) and intercellular adhesion molecule-1 (ICAM-1) (moderate and high evidence, respectively),**
- Effects of PA on E- and P-selectin were inconclusive.
- **PA decreases C-reactive protein (CRP) (high evidence).**
- **The angiogenic factors, endothelial progenitor cells (EPCs) are increased (high evidence)**
- **VEGF is decreased (moderate evidence) by PA.**



# Use It or Lose It

- Sedentary people lose large amounts of muscle mass (20-40%)
- 6% per decade loss of Lean Body Mass (LBM)
- Aerobic activity not sufficient to stop this loss
- Only resistance training can overcome this loss of mass and strength
- Balance and flexibility training contributes to exercise capacity



