Diet Pattern And Longevity: Do Simple Rules Suffice?

David R. Jacobs, Jr, PhD
Mayo Professor of Public Health
University of Minnesota
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Disclosure

Unpaid consultant California Walnut Commission
Are fat and protein food groups?

• According to my 5 year old grandson, taught in a Los Angeles kindergarten, food groups include meat, grains, sugar/candy, fat and protein.
• How did fat and protein, which are nutrients get on a list of foods?
• Why doesn’t his school curriculum distinguish foods from nutrients?
• This funny-sounding story is important and distressing: future consumers are being trained to look at diet in a certain way, using a model in which food is sold by its nutrient content.
“... nutritionism or nutritional reductionism— as I define these concepts here— do not simply refer to the study or understanding of foods in terms of their nutrient parts. ... Rather, it is the ways in which nutrients have often been studied and interpreted, and then applied to the development of dietary guidelines, nutrition labeling, food engineering, and food marketing, that are being described as reductive. This suggests that there are other (nonreductive) ways in which nutritional knowledge can be developed and applied.”
The nutrient approach has broad political and social implications

- In “nutritionism”, dietary advice is reduced to statements about a few nutrients.
- I think a broader focus on foods would alter the scientific and political cascade
  - More healthful diet for many people
  - Different relationship between the public and the food industry.
- I note that vegetarianism is food-oriented, not nutrient-oriented
Food, Not Nutrients, Is the Fundamental Unit in Nutrition

• Linda Tapsell and I argued this in a Nutrition Reviews article (2007)
• Nutrients are known to cure deficiencies, but isolated nutrients greatly in excess of what is obtainable by diet have been neutral or sometimes harmful in randomized clinical trials
We know a lot about diet to prevent CVD, diabetes, and other conditions

- Mediterranean-type Diet
  - low meat and detrimentally processed foods
  - high fruit, vegetables, legumes, whole grains, nuts, berries, seeds generally, unrefined unsaturated oils, fish
  - perhaps dairy, coffee, tea, chocolate, alcohol (not in excess)
What the food industry is faced with to prosper

- I like Post Cereals
- Advertising: any way to get a market wedge (hedging their bets)
  - Food: whole grain, nuts, berries
  - Less processed
  - Fiber
  - Antioxidants (equated with vitamins C and E)
  - Implies low fat (3g total)
Another example of a good food made slightly worse by a nutrient focus and for profit

- Wish-Bone Salad Dressing
- Contains soybean as well as olive oil (despite the name)
- Lots of other stuff for taste (sugar, salt), shelf life, color: do we need it?
Food Synergy is concerted action: Many constituents of individual foods and dietary patterns acting together on health

- Food consists of nonrandom complex mixtures of compounds, developed under evolutionary control
- The composite nature of food, serving the life of the organism being eaten as well as the life of the eater, is central to the food synergy concept.
- Viability of food synergy idea implies
  - Balance in the biochemical constituents of the organism being eaten
  - Pieces of this orchestration survive digestion
  - Coordinated constituents mutually affect human biology
There are probably thousands of compounds in the smallest morsel of food. One small change in a molecule has a huge effect on health. This form of trans fat does not occur in nature.

Example from Wikipedia of fatty acid structure and desaturation
Nutrition (fostering of health through diet) differs fundamentally from treatment of disease

- In health, complex body systems function in harmony
- Evolution achieves a degree of robust function in both the organism eaten and the organism doing the eating
- The constituents of food are biologically active and can be toxic in isolation.
  - The constituents must be orchestrated such that different constituents provide checks and balances
- Food has a biologic and social safety net
  - The mixture of food constituents acts in concert
  - Humans tell each other about things that make them sick
Drugs work through pathway interruption

- Drugs are isolated chemicals, whether synthetic or originally derived from living organisms
  - Doses much larger than the same substance from food
  - No orchestrated concomitant constituents to create balance

- Drugs block a pathway gone wrong, perhaps to the detriment of other pathways
  - Statins inhibit cholesterol synthesis in hopes of reducing cholesterol supply to atherosclerotic plaque
  - Cholesterol synthesis is critical for many body systems and inhibition could ultimately cause harm
  - Small risks of rhabdomyolysis and diabetes
Food is more complex than drugs, but investigated as if it were simpler and less important

- Functional food idea: beyond basic nutrition
- This seems ridiculous to me: basic nutrition is what keeps the multi-faceted organism working well
- It is unlikely that adding isolated substances to food can improve on nature
Cycle of Misinterpretations of Nutrients/Bioactive Compounds

Regulation: definitions set “objective standards”

Whole grain food should have 51 whole grain by weight and 2 g fiber

Media: likes controversy, presenting both sides, should be simple

Emphasize contradictory findings between studies

Public: not experts, want clear advice

Listens to advertising, true believers

Counts water, doesn’t work for rice

Answer is not simple (whereas “eat apples” is simple)

Not equipped to sort through contradictory messages, cannot “take no action” on indeterminate findings
What if the policy is wrong?

- Low fat message ignored good fats, missed subtleties of food
- Industry response was to corrupt the food supply with low-nutrition foods
Infrastructure is inadequate

- “Science” tends to be reductionist, hard to get food studies past reviewers unless the food is taken apart
  - Assumption that such deconstruction does not miss important synergies
- Regulation misses the point, encourages simple solutions that are likely to be incorrect
- Set aside or required moneys for food and pattern studies are not there
Many cohort studies find reduced chronic disease with various diet patterns

➢ In general, plant-centered and vegetarian diets have favorable chronic disease outcomes

➢ This is one of the most consistent findings in nutritional epidemiology

➢ A focus on dietary patterns may advance nutrition science and the political cascade

➢ We created a diet quality score based entirely on foods
Forming the A priori Diet Quality Score

- Select moderately detailed food groups (grams or sv/wk)
- Nutrition experts rate the groups as “favorable (+)”, “adverse (-)”, “neutral (0)"
  - There is substantial agreement among raters
- Because the raters are expert, the ratings will be partly evidence based, but latitude is given for opinion
- Place the groups in quintiles (0 group and quartiles if nonconsumers are common)
- The score is the sum over food groups of quintile ranking (0 to 4) for + groups and 4 - quintile ranking (4 to 0) for – groups. 0 groups do not affect the computation
- Each point is a one category change in one food group
- Assuming energy balance, eating any food group limits choice for other food groups
  - choosing more –or 0 groups tends to reduce the score
<table>
<thead>
<tr>
<th>Food Category</th>
<th>A Priori Diet Quality Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vegetables</td>
<td>(+)Beans and legumes, green vegetables, other vegetables, tomato, tomato</td>
</tr>
<tr>
<td>Fruit</td>
<td>(-) Fried potatoes</td>
</tr>
<tr>
<td>Nuts and soy protein</td>
<td>(0) Potatoes</td>
</tr>
<tr>
<td>Meat</td>
<td>(+)Fruit</td>
</tr>
<tr>
<td>Grains</td>
<td>(+)Seeds and nuts, soy products</td>
</tr>
<tr>
<td>Trans fat/salt</td>
<td>(-)Red meat, liver, processed meat</td>
</tr>
<tr>
<td>Fats</td>
<td>(+)Fish, poultry</td>
</tr>
<tr>
<td>Alcohol</td>
<td>(0) Eggs</td>
</tr>
<tr>
<td>Other beverages</td>
<td>(+)Whole grain</td>
</tr>
<tr>
<td></td>
<td>(+)Low fat dairy, oil</td>
</tr>
<tr>
<td></td>
<td>(-) Salty snacks, sweets</td>
</tr>
<tr>
<td></td>
<td>(-) Fried foods, butter, whole fat dairy</td>
</tr>
<tr>
<td></td>
<td>(+) Beer, liquor, wine</td>
</tr>
<tr>
<td></td>
<td>(+) Coffee, tea</td>
</tr>
<tr>
<td></td>
<td>(-) Soft drink</td>
</tr>
<tr>
<td></td>
<td>(0) Diet soft drink</td>
</tr>
</tbody>
</table>
Diet Pattern is a Personal Characteristic

- Recent years increase of study of diet in patterns
- We introduced an *A Priori* Diet Quality Score
- We recently showed that this pattern was a personal characteristic, in that it tracked ($r = 0.6$) over 20 years in CARDIA
  - 5115 black and white men and women aged 18-30, recruited in 1985-86, 4 US centers, examined 8 times (diet in years 0, 7, 20)
  - Diet pattern not as subject to within person variability as are nutrients or foods

Lockheart et al BJB 2007
CARDIA study: *A Priori* Diet Quality Score improved with age, though it worsened with calendar time in the general population; yet rank was generally maintained. Adjusted means (95% confidence interval); n=4962 at year 0 (1985-86), 3803 at year 7 (1992-93) and 3057 at year 20 (2005-06)

\[1\] Adjusted for sex, race, center, and total energy (Kcal/d)

Iowa Women’s Health Study (IWHS)

- IWHS is 41,836 women aged 55-69 in 1986, recruited from Driver’s License information, 42% response
- Questionnaire and record linkage study
- 1986: n = 29,634 no heart disease, diabetes or cancer at baseline and adequate FFQ (10,343 deaths thru 2008)
- Tracking of A Priori Diet Quality Score over 18 years in IWHS: r=0.55
### Diet Pattern Predicts Mortality in the IWHS: Quartiles

<table>
<thead>
<tr>
<th>Quartile of a priori diet quality score</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>P for trend $^1$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Median (Range)</td>
<td>29 (10-32)</td>
<td>36 (33-38)</td>
<td>41 (39-43)</td>
<td>48 (44-68)</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Total mortality</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cases (n)</td>
<td>2654</td>
</tr>
<tr>
<td>Participants (n)</td>
<td>7015</td>
</tr>
<tr>
<td>Person-years (y)</td>
<td>139,951</td>
</tr>
<tr>
<td>Adjusted Hazard Ratio</td>
<td>1.00 (0.88, 0.98)</td>
</tr>
<tr>
<td>Adjusted Death Incidence Density/100 py in 22 years followup</td>
<td>36.9</td>
</tr>
</tbody>
</table>
## Meat intake in IWHS

<table>
<thead>
<tr>
<th>Meat item</th>
<th>Mean ± SD sv/wk</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Meat</td>
<td>11.3±6.0</td>
</tr>
<tr>
<td>Red Meat</td>
<td>5.9±4.0</td>
</tr>
<tr>
<td>Processed Meat</td>
<td>1.9±2.4</td>
</tr>
<tr>
<td>Organ Meat</td>
<td>0.3±0.7</td>
</tr>
<tr>
<td>Fish and Seafood</td>
<td>1.7±2.0</td>
</tr>
<tr>
<td>Poultry</td>
<td>1.8±1.9</td>
</tr>
<tr>
<td>&lt;½ serving / day</td>
<td>3.8 (1121)</td>
</tr>
<tr>
<td>Red Meat, Fish and Poultry -</td>
<td></td>
</tr>
<tr>
<td>Processed and Organ</td>
<td>7.2±5.2</td>
</tr>
<tr>
<td>Fish and Poultry -</td>
<td></td>
</tr>
<tr>
<td>Red, Processed, and Organ Meat</td>
<td>4.6±6.1</td>
</tr>
</tbody>
</table>
### Total meat intake in quartiles in IWHS total deaths/100 py in 22 years

<table>
<thead>
<tr>
<th></th>
<th>Q1</th>
<th>Q2</th>
<th>Q3</th>
<th>Q4</th>
<th>P for trend</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Model 1</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total meat</td>
<td>33.8</td>
<td>33.7</td>
<td>32.8</td>
<td>33.8</td>
<td>0.37</td>
</tr>
<tr>
<td><strong>Model 2</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total meat</td>
<td>33.7</td>
<td>33.8</td>
<td>32.7</td>
<td>33.5</td>
<td>0.49</td>
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<tr>
<td>A priori score</td>
<td>36.9</td>
<td>34.6</td>
<td>32.5</td>
<td>30.2</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td><strong>Model 3</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total meat</td>
<td>33.6</td>
<td>33.7</td>
<td>32.8</td>
<td>33.7</td>
<td>0.33</td>
</tr>
<tr>
<td>A priori score w/o meat</td>
<td>36.4</td>
<td>35.5</td>
<td>32.1</td>
<td>30.4</td>
<td>&lt;0.0001</td>
</tr>
</tbody>
</table>

Adjusted for age, energy intake, marital status, education, residence, hormone replacement therapy, physical activity, and smoking
Meat composite: processed + organ – (red + poultry + fish) in quartiles in IWHS total deaths/100 py in 22 years

<table>
<thead>
<tr>
<th></th>
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<th>Q3</th>
<th>Q4</th>
<th>P for trend</th>
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<tr>
<td><strong>Model 1</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Meat Comp</td>
<td>32.2</td>
<td>32.5</td>
<td>33.7</td>
<td>35.4</td>
<td>0.01</td>
</tr>
<tr>
<td><strong>Model 2</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Meat Comp</td>
<td>32.8</td>
<td>32.7</td>
<td>33.6</td>
<td>34.6</td>
<td>0.3</td>
</tr>
<tr>
<td>A priori score</td>
<td>36.7</td>
<td>34.5</td>
<td>32.5</td>
<td>30.4</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Meat Comp</td>
<td>32.6</td>
<td>32.6</td>
<td>33.5</td>
<td>34.8</td>
<td>0.12</td>
</tr>
<tr>
<td>A priori score w/o meat</td>
<td>36.2</td>
<td>35.4</td>
<td>32.2</td>
<td>30.5</td>
<td>&lt;0.0001</td>
</tr>
</tbody>
</table>

Adjusted for age, energy intake, marital status, education, residence, hormone replacement therapy, physical activity, and smoking
The a priori score, but not meat intake, was strongly related to mortality in IWHS

- The a priori diet quality score predicted about 6/100 py over 22 years absolute difference in death, graded across quartiles, independent of meat intake
- Meat intake did not affect this finding
- A meat composite (processed + organ – (red + poultry + fish) had a small, but non-significant association with death
Adventist Health Study (AHS)-2

- The AHS-2 sample, 96,000 people, is 30-112 years old, mostly whites and blacks, men and women, free-living.
- About half are vegetarians, those who eat meat tend not to eat much.
- It is well-established that Adventists as a group have a very favorable chronic disease experience.
AHS-2: a priori score, vegetarian status, and total mortality

• We implemented a score similar to the IWHS a priori score in an AHS-2 subsample, n = 41,762

• Correlation in 906 over 1-3 years was 0.74
  • As in CARDIA and IWHS substantially higher than most individual food groups
Diet Pattern Predicts Mortality in the AHS-2: Quintiles

<table>
<thead>
<tr>
<th>Quintile of a priori diet quality score</th>
<th>Q1</th>
<th>Q2</th>
<th>Q3</th>
<th>Q4</th>
<th>Q5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Median (Range)</td>
<td>65 (40-70)</td>
<td>75 (71-78)</td>
<td>82 (79-84)</td>
<td>88 (85-91)</td>
<td>96 (92-119)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Total mortality</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Cases (n)</td>
<td>418</td>
<td>477</td>
<td>462</td>
<td>479</td>
<td>394</td>
</tr>
<tr>
<td>Participants (n)</td>
<td>7988</td>
<td>8467</td>
<td>8033</td>
<td>8800</td>
<td>8474</td>
</tr>
<tr>
<td>Person-years (y)</td>
<td>47161</td>
<td>50284</td>
<td>47688</td>
<td>52300</td>
<td>50483</td>
</tr>
<tr>
<td>Adjusted Hazard Ratio</td>
<td>1</td>
<td>0.81</td>
<td>0.76</td>
<td>0.71</td>
<td>0.63</td>
</tr>
<tr>
<td></td>
<td>(0.71-0.92)</td>
<td>(0.67-0.87)</td>
<td>(0.62-0.81)</td>
<td>(0.55-0.72)</td>
<td></td>
</tr>
<tr>
<td>Adjusted Death Incidence Density/100 py in 22 years followup</td>
<td>3.7</td>
<td>3.0</td>
<td>2.9</td>
<td>2.7</td>
<td>2.4</td>
</tr>
<tr>
<td></td>
<td>p trend &lt;0.0001</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Adjusted for age, energy intake, sex, black race (not adjusted for smoking or alcohol: 1.1% were current smokers and 6.6% were current alcohol users)
Mortality by quintiles of a priori score, within dichotomous vegetarian status, adjusted for age, race, sex, kcal. SDA-2 to 12/31/2009

Cumulative incidence density per py in 8 yr

P interaction = 0.02

Mean Nonvegetarian meat consumption
- AHS-2: 64 g/d
- IWHS: 290 g/d (180 g sv)

A priori diet quality score quintile

P = 0.009
P < 0.0001
P = 0.008
Comments about the a priori score

- The a priori score is a “sensible” approach to diet, highly correlated with other successful diet patterns, but based only on foods, associated with reduced chronic disease and death.
- It favors less processed, phytochemical rich plant food: a plant-centered diet
- A palatable diet is a mix
  - Because of taste, meal composition, social aspects of food, no one gets close to the theoretical minimum or maximum
- A range of diets are healthful.
- A high score can be achieved with substantial flexibility in food choice, but tends to minimize meat, salt, added sugar, and heavily processed foods, while emphasizing phytochemical rich foods. It doesn’t forbid any food.
  - These principles are true even within vegetarians.
Beyond the a priori score: a platform for study from complex to less complex

• Not every element of the a priori score has equal certainty in its rating

• To approximate many vegetarian diets, we changed ratings of all meat, cheese and other dairy to “–” and fruit juice and coffee to “0”

• This did not change much within Adventists ($r = 0.95$ of the presented score with this altered score)

• A similar strategy might change prediction in omnivores

• It is a priority to “deconstruct” the score: which variants would preserve or improve prediction of chronic disease?
  • This is such a massive topic that I have only begun to address it

• As illustrated here, a powerful nutritional epidemiologic method is to examine an individual food such as meat, holding constant the score’s predictions
No restriction on Total or Saturated Fat does not mean high meat

- Southern European Atlantic Diet (SEAD) and nonfatal AMI. Oliveira A et al. AJCN 2010
- Population-based case-control study in Porto, Portugal, aged ≥18 y.
- 820 hospitalized incident AMI, 2196 randomly selected controls
  - SEAD adherence 0-9 points (above median): fresh fish excluding cod, cod, red meat and pork products, dairy products, legumes and vegetables, vegetable soup, potatoes, whole-grain bread, and wine.
- Highest SEAD quartile (best adherence to traditional pattern vs lowest quartile) 33% lower AMI risk (OR: 0.67; 95% CI: 0.51, 0.88; P for trend = 0.003).
- A SEAD index calculated by reverse scoring for red meat and pork products led to an even stronger association: 60% lower AMI risk (upper vs lower quartile: (OR: 0.45; 95% CI: 0.34, 0.60; p for trend < 0.001).
Simple Rules to Make a Pattern?

I expand Michael Pollan’s aphorism and incorporate my own and Gyorgy Scrinis’ aversion to detrimental processing, but maintain individual dietary flexibility:

Eat Foods, Mostly Plants, Not Too Much, In Colorful Variety, Maximizing Nutrients per Bite

Eat Foods = avoid many forms of industrial processing that degrade access to the nutrients/phytochemicals/beneficial compounds

Mostly Plants = plant centered diet (remember the environmental cost of converting plants to animals!)

Not Too Much = energy balance (but some formulations are apparently not detected by the body as energy intake)

In Colorful Variety = this is a clue to phytochemical content and a good way to keep track of eating a variety of plant foods

Maximizing Nutrients per Bite = a reminder that our energy expenditure is low and we shouldn’t waste it on foods that have low nutritional quality = detrimental processing
General Conclusions

• Not all vegetarian diets are equal
• From the perspective of chronic disease, it seems that the presence of phytochemical rich plant food rather than the complete absence of animal food is what makes a vegetarian diet so successful
• From the perspective of getting a healthy diet to the masses, we need a clever political solution that delivers good food while making a profit for farmers and the food industry
• From the perspective of sustainability to feed billions of people, feeding animals plants, then eating the animals will not work, certainly not to the extent we currently do it
Final Note

- Pollution is another issue. In a recent editorial (Brit J Nutr, 2012) on why fish was not inversely related to incidence of diabetes, Jerome Ruzzin and I wrote and extensive presence of PCBs (polychlorinated biphenyls):
- “This discouraging state of affairs has probably emerged through human intervention in the lives of the fish, both through exposure to a wide variety of chemical contaminants and through substantial alteration in fish composition as fish source has moved from fish caught in the wild to fish farmed for financial profit.
- These studies may be taken as a warning for the need to maintain stewardship of the land and the sea, as we strive for adequate quality of life in an increasingly populous earth.”
Thank You
Saturated Fat association with incident CVD depends on food it is in

- Population-based sample aged 45-84, free of clinical CVD and diabetes
- Median SAFA 18 g/d: dairy 39%, meat 21%, butter 4%, plant 6%, mixed sources 30%
  - Majority was palmitic acid, C16:0

Oliveira Otto et al. AJCN 2012
Saturated Fat intake by food source and CVD incidence, MESA n = 5209, 316 cases in 7 yrs

Adjustment: age, sex, race-ethnicity, study center, energy intake, education, alcohol intake, physical activity, BMI, cigarette smoking, dietary supplement use, use of cholesterol lowering medication, intakes of fruits and vegetables, dietary fiber, dietary vitamin E, trans fat and PUFA).
Saturated Fat intake, cholesterol, and CVD

- Saturated fat from meat was associated with future CVD events, but saturated fat from dairy was inverse.
- Very convincing studies that saturated fat intake increases total cholesterol
  - Largely in the LDL-C fraction (lowers HDL-C)
  - Changes may be in large, less dense LDL particles, not as risky as small, dense LDL particles
  - Importantly: saturated fat is not the only thing in saturated fat containing food
- In this light nutrient-based recommendation to reduce saturated or total fat doesn’t make sense.

1. Fat intake recommendations must be within a food-based approach to CHD prevention in the whole diet context.

2. Consume nutritionally adequate diets that are low in saturated fat and as low as possible in trans-fat.

3. Nutritionally adequate diets should fulfill the requirements for the intake of n-6, n-3 and cis-MUFA fatty acids.

4. Natural experiments showed that both traditional Mediterranean and Japanese diets were associated with a low risk of CHD.