

**Do whole grains make you sick and
fat? A perspective on the
healthfulness of whole grains as
seeds in an overall
healthful dietary pattern.**

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Disclosures

- Consultant, California Walnut Commission
- Faculty member University of Minnesota since 1974
- Mostly NIH funded since 1974
- Guest Professor at University of Oslo, Norway since 2000

Eating whole grain compared to refined grain does not lead to weight gain

- Inverse association cross-sectionally
- Wholeheart study, Brownlee, Brit J Nutr, 2010

Weight (kg)	N	Week 0	Δ Week 8	Δ Week 16
No diet change	100	86.7	0	-0.7
60 g/d	85	87.1	-0.2	-0.8
60/120 g/d	81	86.7	0.7	-0.5

Brouns et al. Does wheat make us fat and sick? Journal of Cereal Science 58 (2013) 209-215

We know a lot about diet to prevent CVD, diabetes, and other conditions

- Prudent/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)
- Based on cohort studies and PREDIMED

We know less about the parts of this diet pattern

- Whole grain food intake is consistently inverse to chronic disease outcomes in cohort studies, but no clinical trial
- Can we bolster judgment about the causal relationship using logic other than a clinical trial?

Seeds: Theory

- Eating whole cereal grain (wheat, oats, rye, corn, rice, etc, all are seeds) predicts lower CVD and total death
- Nuts, chocolate, coffee, berries
- Seeds have diverse botanical compounds for new plant
- Compounds mostly xenobiotic in animals
- Needed in great diversity for health, yet still treated as foreign to our bodies, used by our bodies, but still excreted after days (so need frequent replenishment)
- Variety in consumption helps. Many compounds, many functions. We don't know in advance of eating which is needed on any given day.
- Holistic/synergistic perspective: single compounds don't matter in the long run

1. Consumption of Plant Seeds and Cardiovascular Health Epidemiological and Clinical Trial Evidence Emilio Ros, Frank B. Hu, *Circulation*. 2013;128:553-565

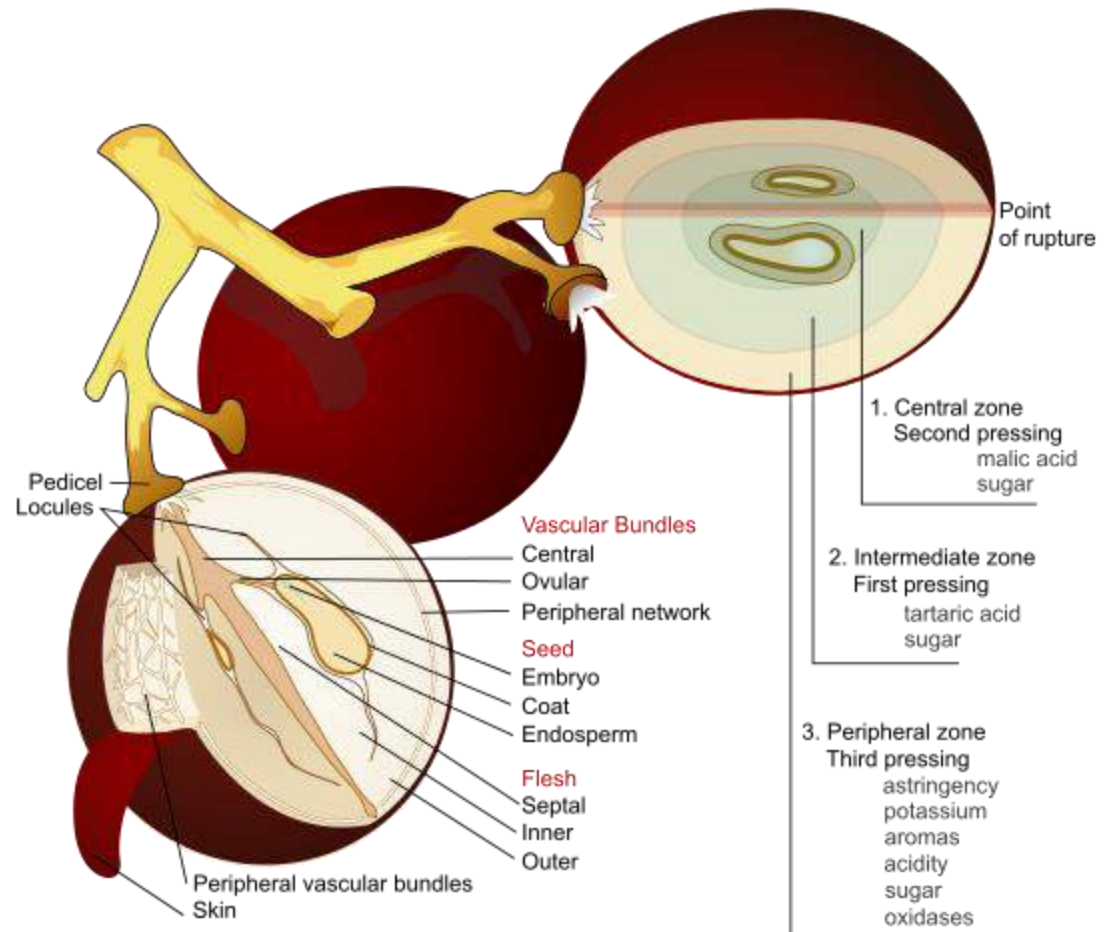
2. The Triumph of Seeds: how grains, nuts, kernels, pulses and pips conquered the plant kingdom and shaped human history, Thor Hanson, Basic Books, 2015

Iowa Women's Health Study (IWHS)

- 41,836 women aged 55-69 in 1986, recruited from Driver's License information, 42% response
- Questionnaire and record linkage
- 1986: n = 28,677 no heart disease, diabetes or cancer, adequate FFQ (13,072 deaths thru 2011)
- We formed an A Priori Diet Quality Score (APDQS: prudent diet), tracking over 18 years: $r=0.55$, excellent prediction total death

Alcoholic Beverages Start with Whole Plant Foods, Often a Cereal Grass Seed

- Grain or other plant food, water, heat, fermenting starter
- Alcohol present for part of process
- Filtration and/or distilling
- Very effective chemical extraction
- Many compounds: large literature on beverage identity



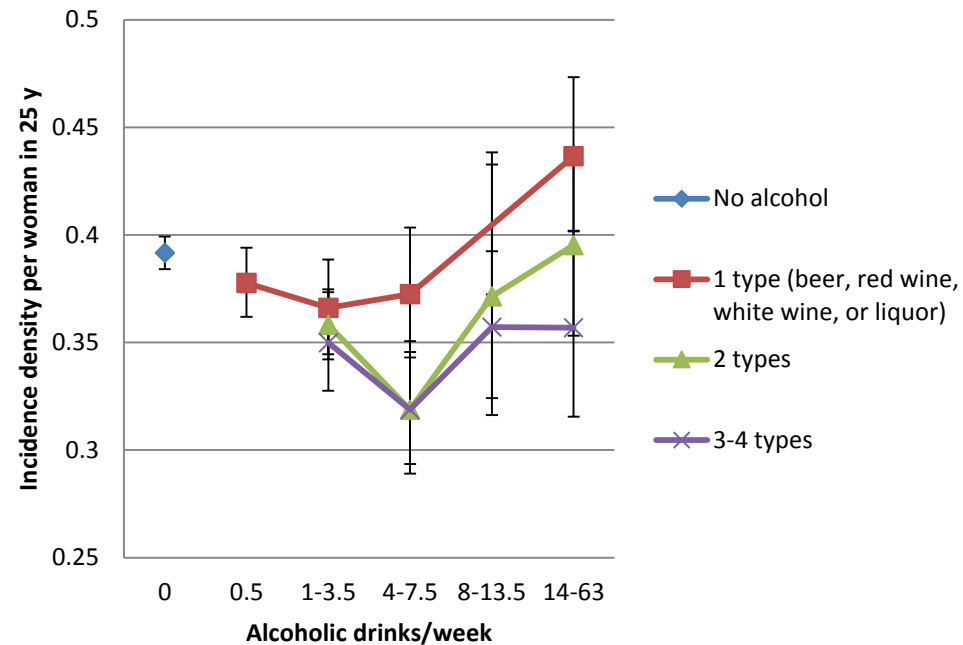
"Wine grape diagram en" by Mariana Ruiz Villarreal (LadyofHats)

http://commons.wikimedia.org/wiki/File:Wine_grape_diagram_en.svg#/media/File:Wine_grape_diagram_en.svg

Alcohol prediction of total death: Incidence density per 100 women in 25 yr

N	Types (Beer, white wine, red wine, or liquor)			
	0	1	2	3
Drinks/ wk				
0	15688			
0.5		3043		
1-3.5		1529	2999	1227
4-7.5		732	737	789
8-13.5		0	221	677
14-63		516	355	248

Total death: both type and amount of alcohol matter



Simultaneous model adjusted for age, marital status, farm residence, education, physical activity, smoking, hormone replacement, energy, seed amount, seed variety, and APDQS

Caution: Alcohol in Excess is Dangerous

- Nutritional interest in alcoholic beverages: focus on preparation of whole food to extract important constituents
- Benefits appear to accrue at low intake, up to about 1 drink per day
- It is well understood that ethanol itself in excess is dangerous to judgment, personal relationships, and automobile operation, among other things.

Distributions of Seeds and Scores, n=28,677

	Seed Food	Mean	SD
		Sv/wk	
1	Strawberries	1.1	1.5
2	Blueberries	0.2	0.5
3	Tomatoes	2.4	2.9
4	Tofu	0.0	0.4
5	Stringbeans	1.9	1.7
6	Peas	1.3	1.2
7	Legumes	0.8	0.9
8	Whole Grain	11.7	8.3
9	Decaf Coffee	6.5	8.7
10	Coffee	10.2	9.7
11	Chocolate	0.9	1.8
12	Candy Bar	0.6	1.1
13	Peanut Butter	1.9	2.8
14	Nuts	1.0	1.7

Item (min, max)	Mean	SD
	Sv/wk	
Total Seed Amount (0, 122)	40.4	15.5
	Seed count	
Total Seed Variety (0, 14)	8.9	2.0
	Scores	
Seed, Alcohol, Energy Composite (-3, 15)	4.7	3.2
A Priori Diet Quality Score (10, 67)	38.2	8.1

Diet prediction of total death

Incidence density per 100 women in 25 y

	Q1	...	Q5	Q5-Q1
Energy intake	36.2	...	39.7	+3.5
APDQS	38.9	...	36.1	-2.8
Seed amount	39.6	...	36.7	-2.9
Seed variety	39.3	...	35.9	-3.4

All “benefit” vs all “adverse”: 12.6% of women still alive

Simultaneous model adjusted for age, marital status, farm residence, education, physical activity, smoking, hormone replacement, and alcohol

Diet prediction of total death

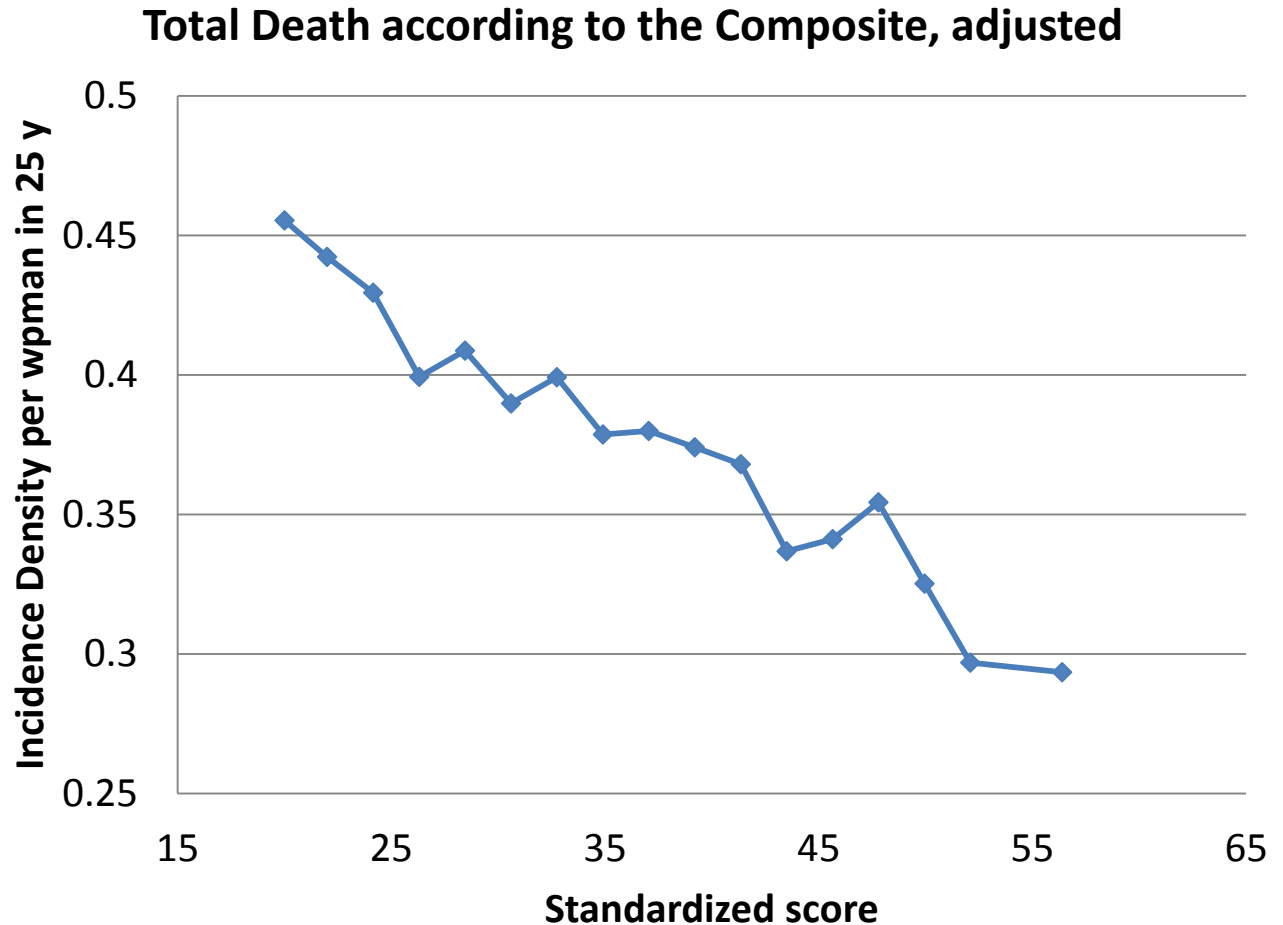
Diet predictor	HR per SD (CI)	X ²	p
Regression 1			
APDQS	0.94 (0.92-0.96)	49.3	<.0001
Regression 2			
Seed, Alcohol, Energy Composite	0.90 (0.88-0.92)	132.8	<.0001
Regression 3			
Seed, Alcohol, Energy Composite	0.91 (0.89-0.93)	92.8	<.0001
APDQS	0.97 (0.95-0.99)	8.7	0.0031
Regression 4			
Composite + APDQS	0.89 (0.88-0.91)	141.3	<.0001

Seed, Alcohol, Energy Composite does most of the work

Each model adjusted for age, marital status, farm residence, education, physical activity, smoking, hormone replacement

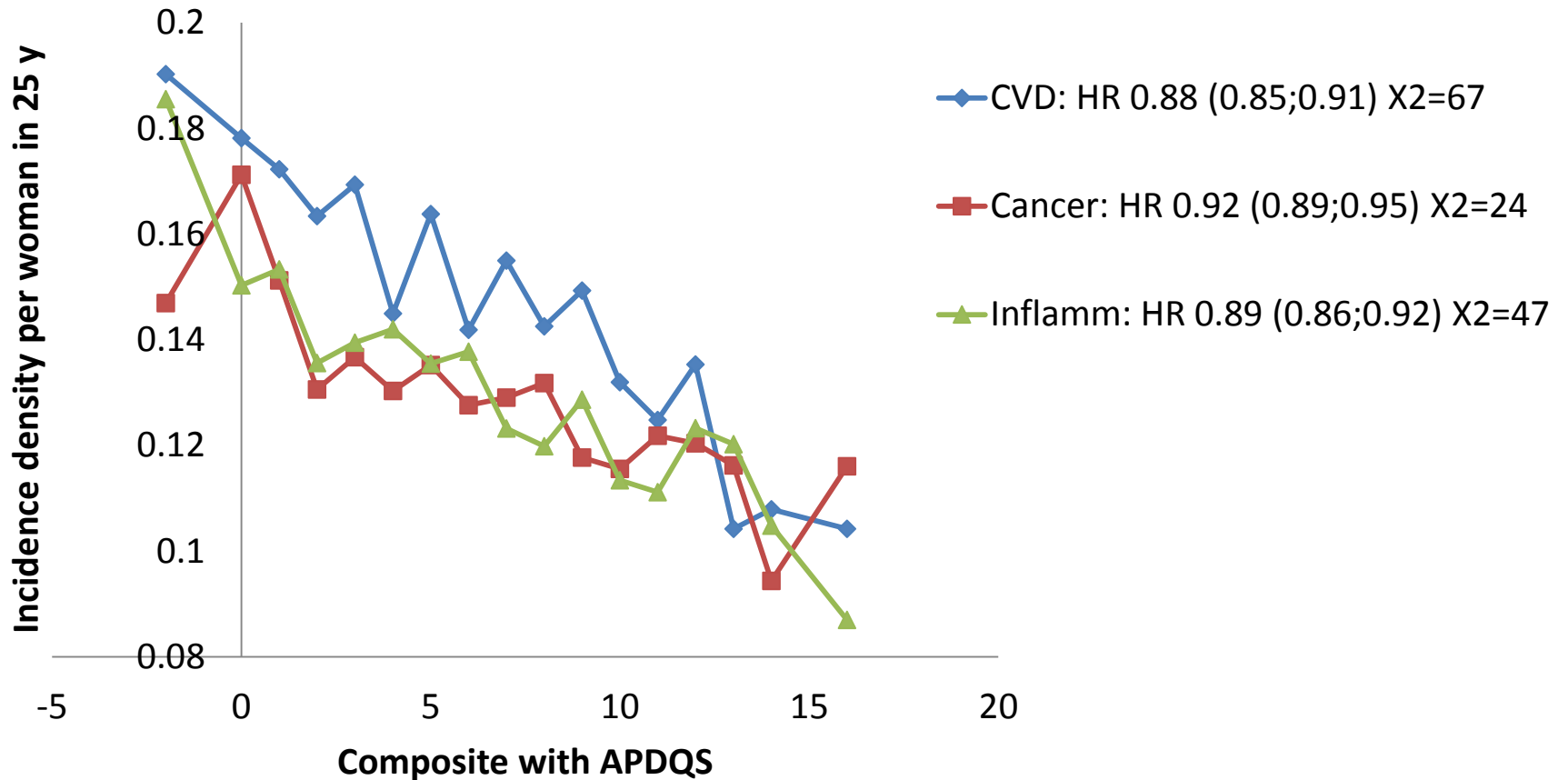
Total Death, Point by Point for APDQS and Seed, Alcohol, Energy, APDQS Composite

Composite	N at risk
15-18	724
14	712
13	989
12	1230
11	1521
10	1867
9	2061
8	2387
7	2525
6	2687
5	2713
4	2552
3	2199
2	1800
1	1342
0	716
-3 to -1	652



CVD, Cancer (weakest), and NonCVD, Noncancer Inflammatory related death all related inversely to the Composite Score (with APDQS, fully adjusted)

Causes of death by Composite Score



Correlation coefficients of Diet Pattern Scores with Nutrients, IWHS, 1986 (adjusted for age and energy intake, except energy intake)

	APDQS	Seed, Alcohol, Energy
Energy intake	-0.02	-0.04
Carbohydrate	0.15	-0.01
Total Protein	0.28	-0.04
Animal Protein	0.15	-0.11
Vegetable Protein	0.37	0.25
Total Fat	-0.43	-0.04
Animal Fat	-0.38	-0.16
Vegetable Fat	-0.04	0.15
Saturated Fat	-0.47	-0.10
Alcohol	0.18	0.15
Dietary Fiber	0.50	0.15

Correlation between pattern scores: 0.40

Whole grain prediction of total death Incidence density per 100 women in 25 y

Servings/Wk	0	1	3	5	7	10	14	23
N at risk	469	3242	1942	3652	2125	5550	6904	5750
Incidence Density	42.4	40.0	39.1	38.1	38.2	38.4	36.4	36.0

Simultaneous model adjusted for age, marital status, farm residence, education, physical activity, smoking, hormone replacement, energy, APDQS, alcohol, Berries, Coffee, Chocolate, Nuts, and FV seeds

Conclusion

- The evidence is consistent and strong for beneficial effects of whole grain foods on chronic disease, including CVD and other conditions likely to be of inflammatory origin.
- In the absence of a long-term, randomized clinical trial of whole grain and chronic disease incidence, there is prediction after adjustment for a powerful dietary score.
- Whole grain foods are seen in the context of a novel theoretical construct, seeds generally.
- Benefits of whole grains are linked with benefits of alcohol consumed in moderation.
- Availability/extraction of a wide variety of seed compounds appears to be important for long term health

Thank You