

Health and Nutrition Modeling: New Approaches

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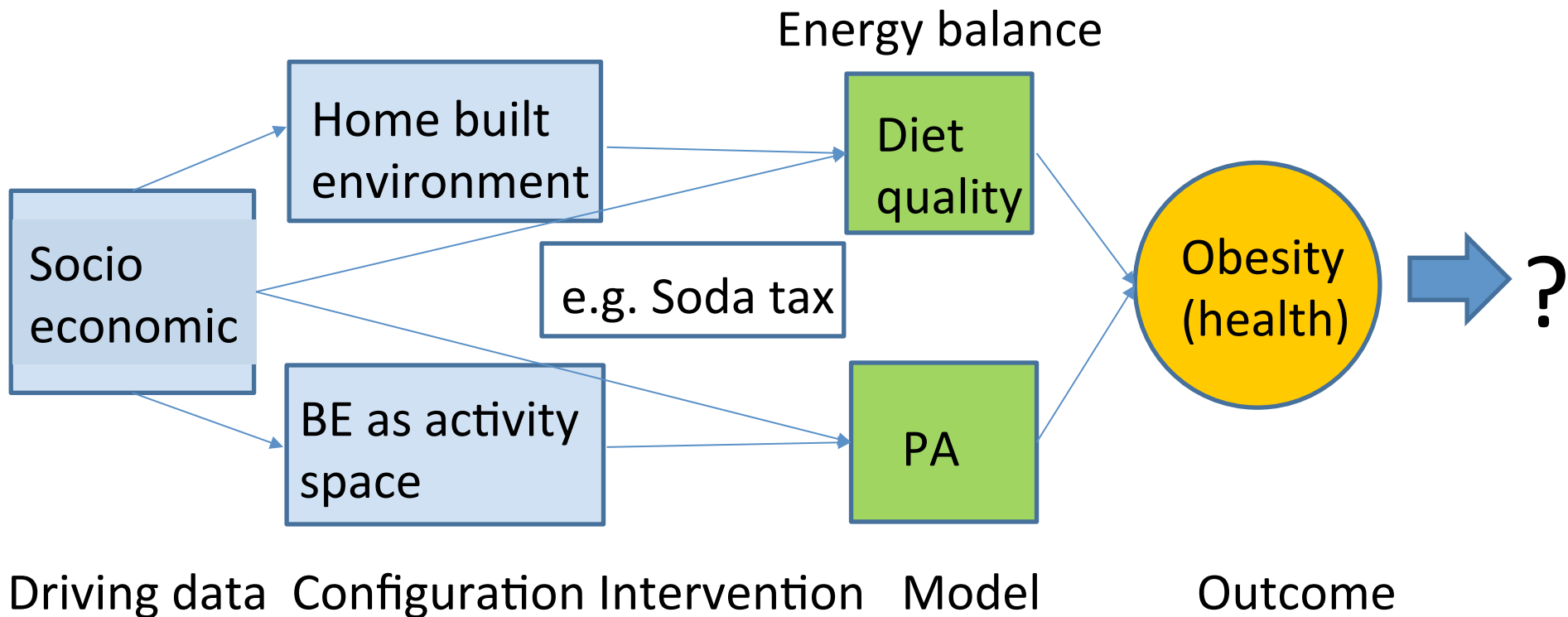
Professor of Epidemiology, School of Public Health

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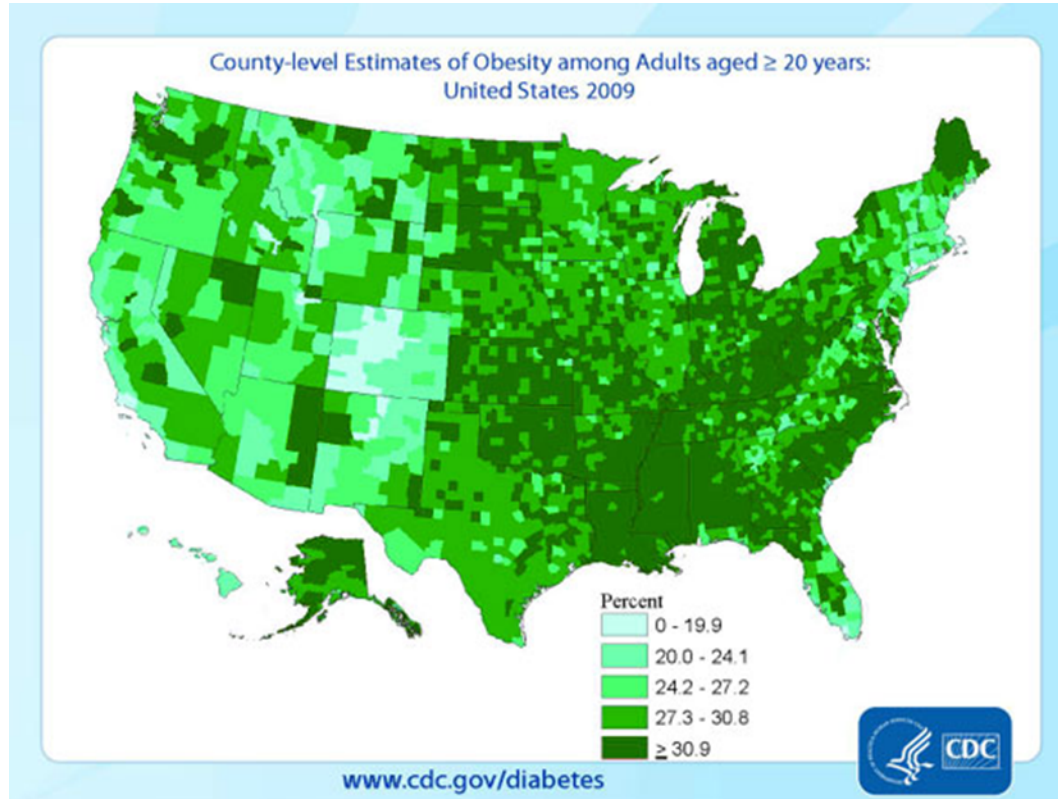
Next Generation Food Shock Modeling Workshop
Aspen Global Change Institute, Aspen, CO May 21 ,2019



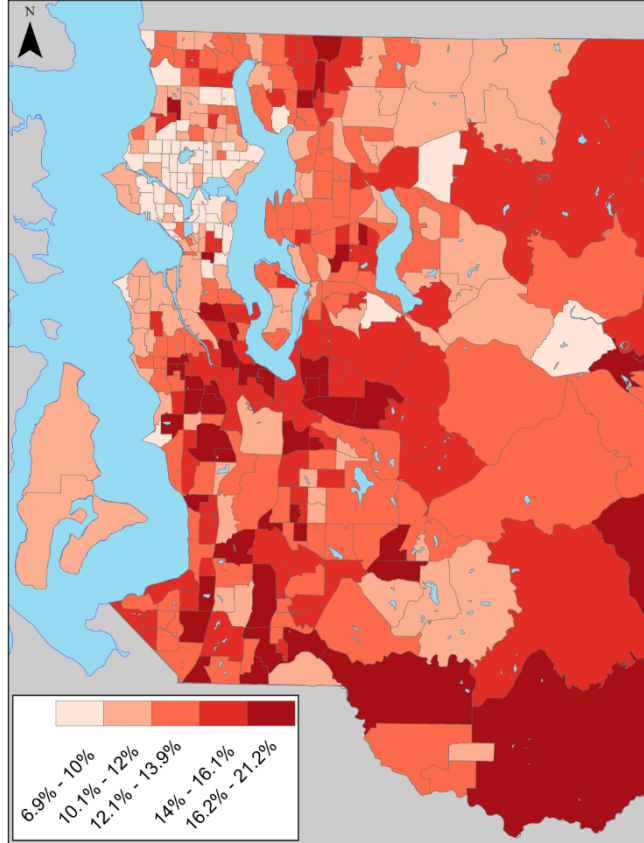
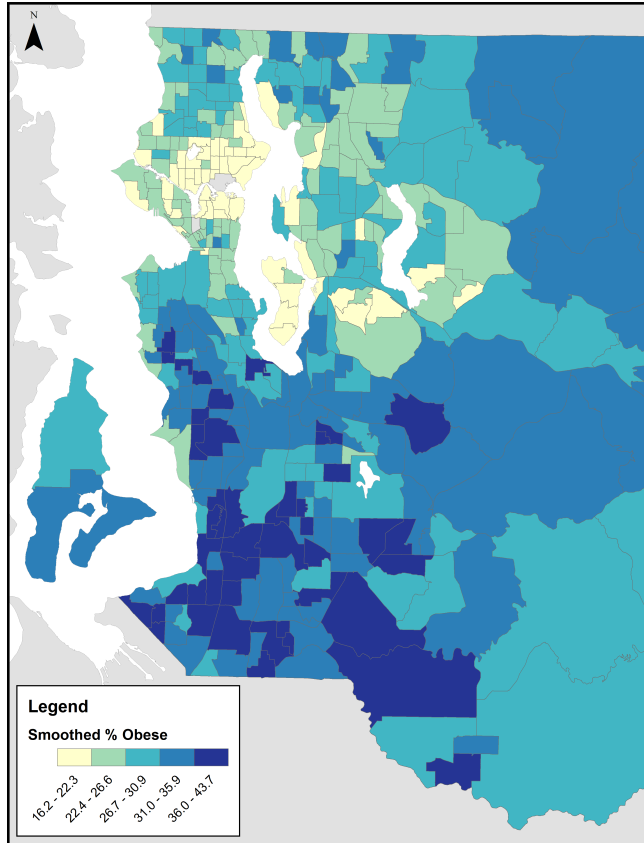
Modeling in Seattle Obesity Study(SOS)



Why do we model?



Census data are easy; health data are hard



Spatial analyses of diagnosed obesity and diabetes for 59,767 insured adults

Mapping obesity in Seattle by census block

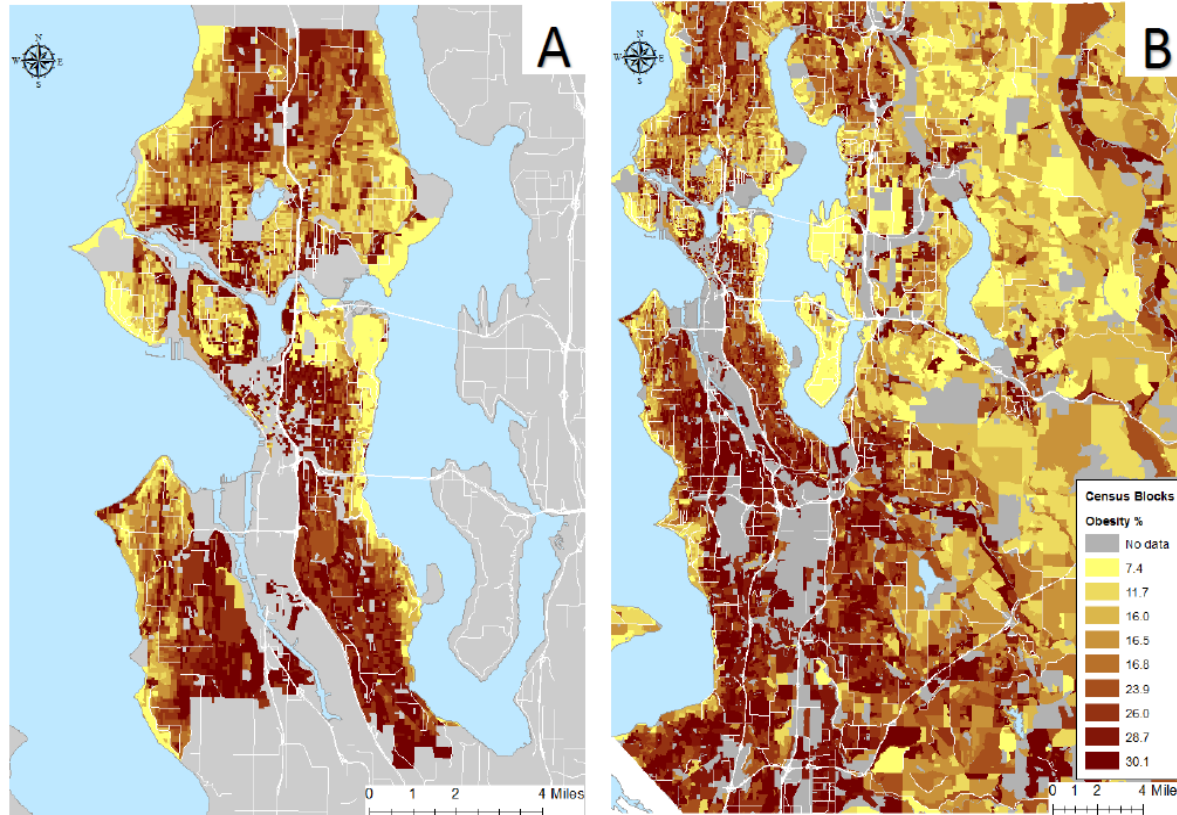
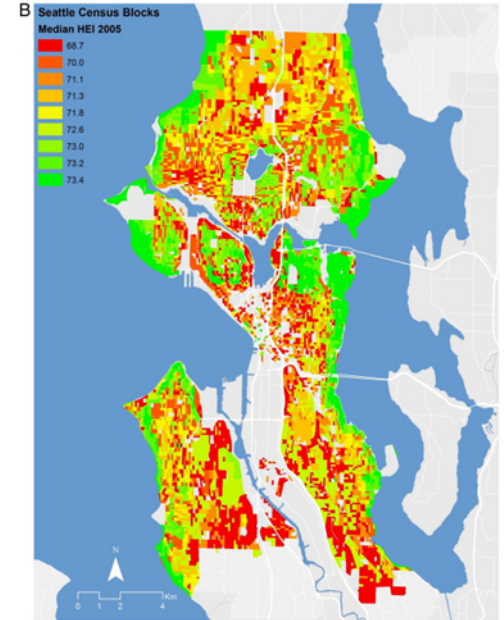
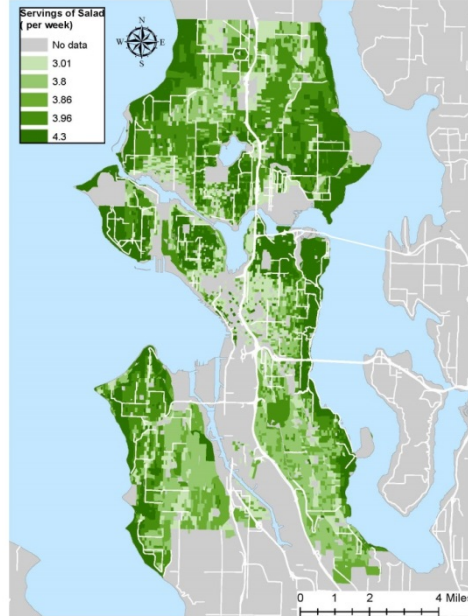
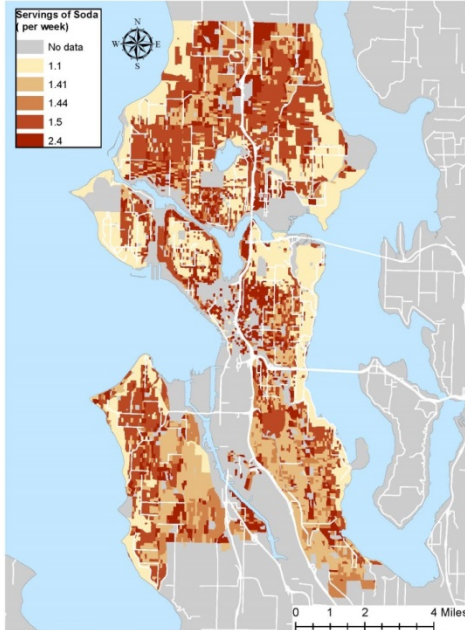


Figure 1: Geographic distribution of tax parcel residential property values (A) and obesity prevalence (B) at the census block level for Seattle.

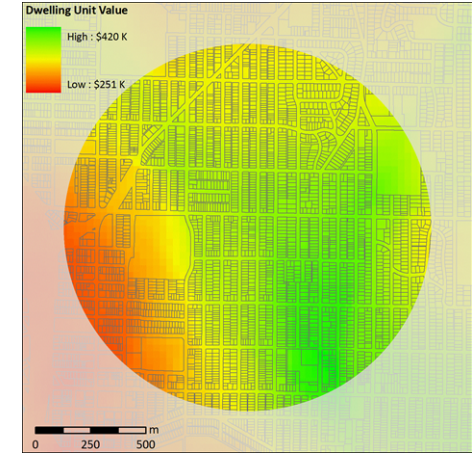
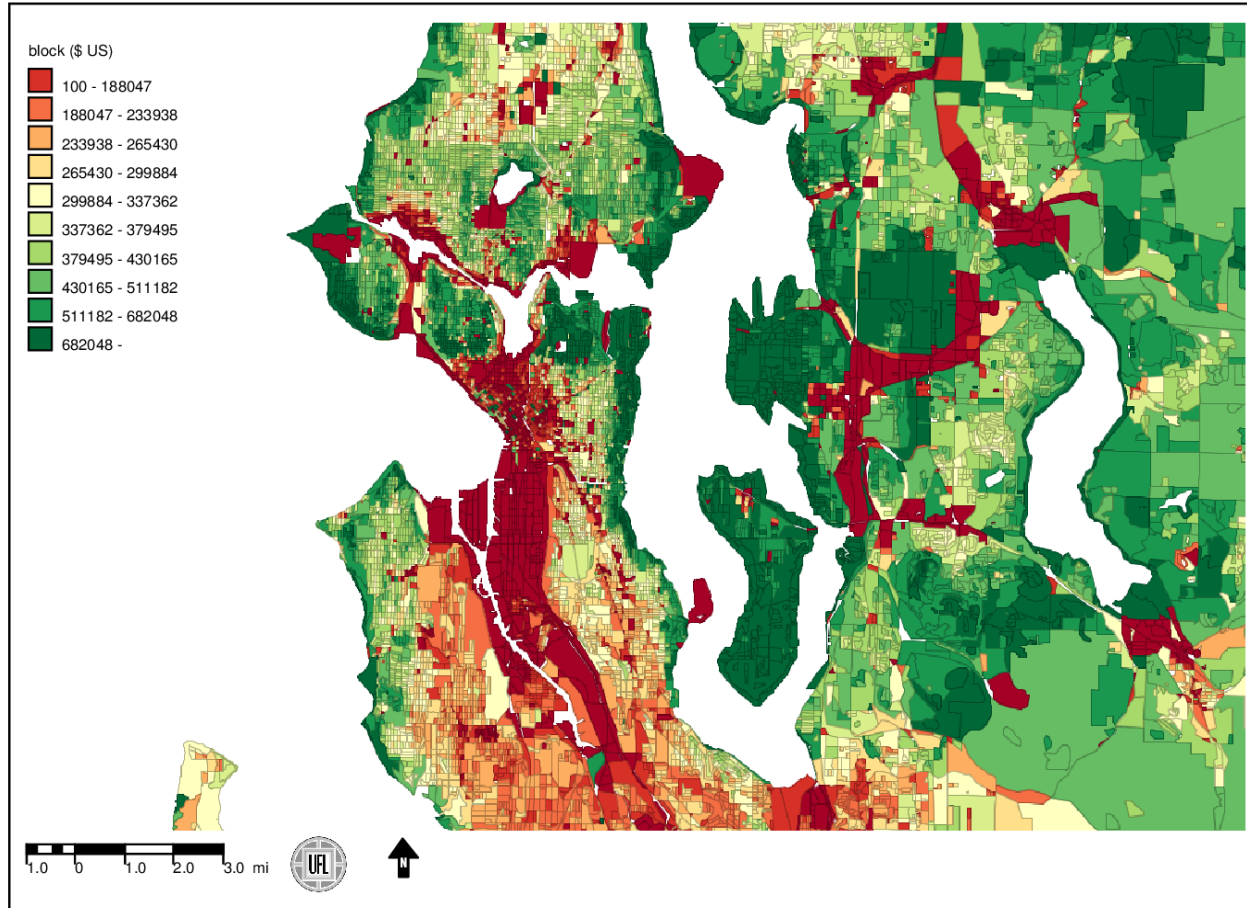
Microsimulation modeling: Mapping diet quality by neighborhood



HEI 2010

Soda (SSB) and salad consumption (servings per week) by Seattle census block

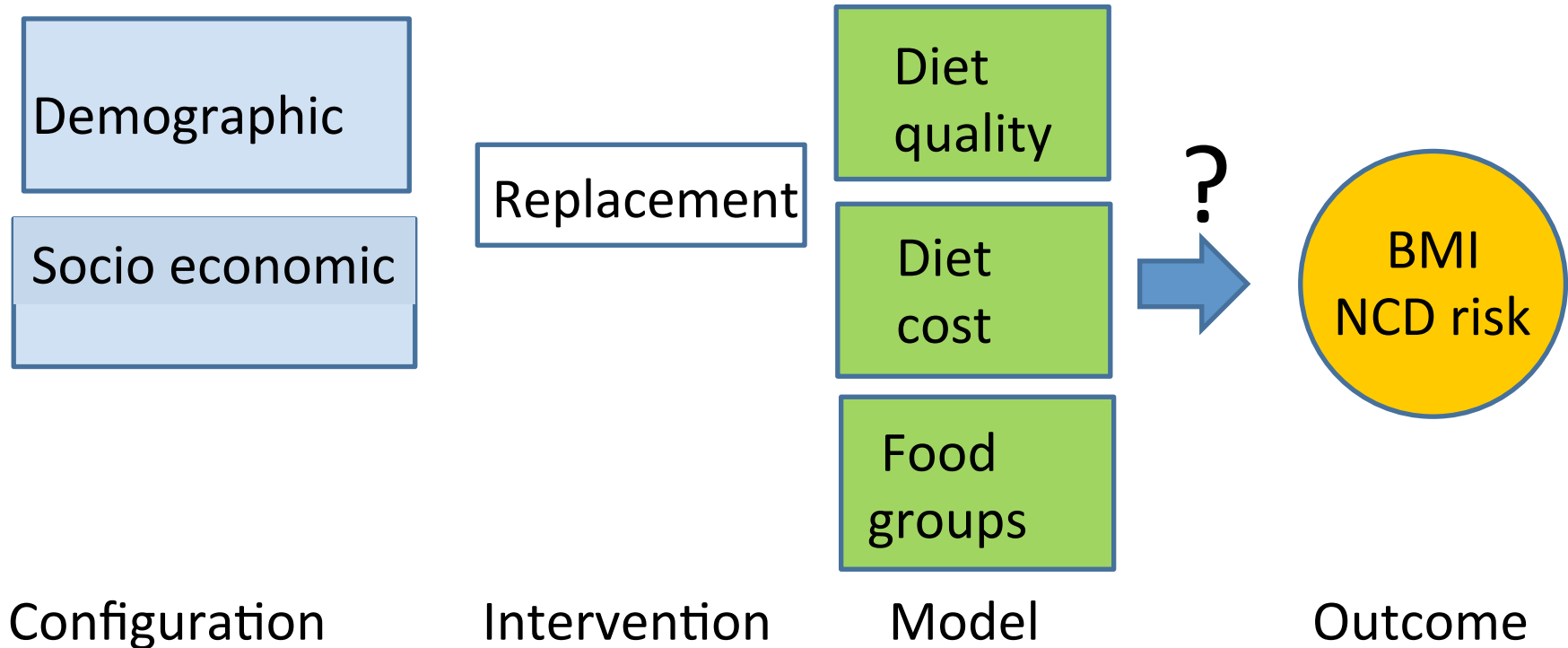
Micro-simulation based on residential property values



A 30 m sampling grid is created for the entire KC area (>6,000,000 points).

Each point is visited serially (moving window or kernel function). Individual values are normalized to a “mean value per dwelling unit” and smoothed to create a spatially continuous surface.

Other examples of modeling diets and health



Dietary substitution models

- Replace foods with other foods
 - Replace typical snacks with tree-nuts.
 - Replace the American breakfast with RTE cereals.
 - Replace 100% juice with whole fruit
 - Replace milk with plant milk
- Replace nutrients with other nutrients.
 - Replace dairy fat with PUFAs
 - Replace animal proteins with plant proteins.
 - Replace “Western” diets with vegan diets.
- Diet quality and/or NCD risk are outcomes.



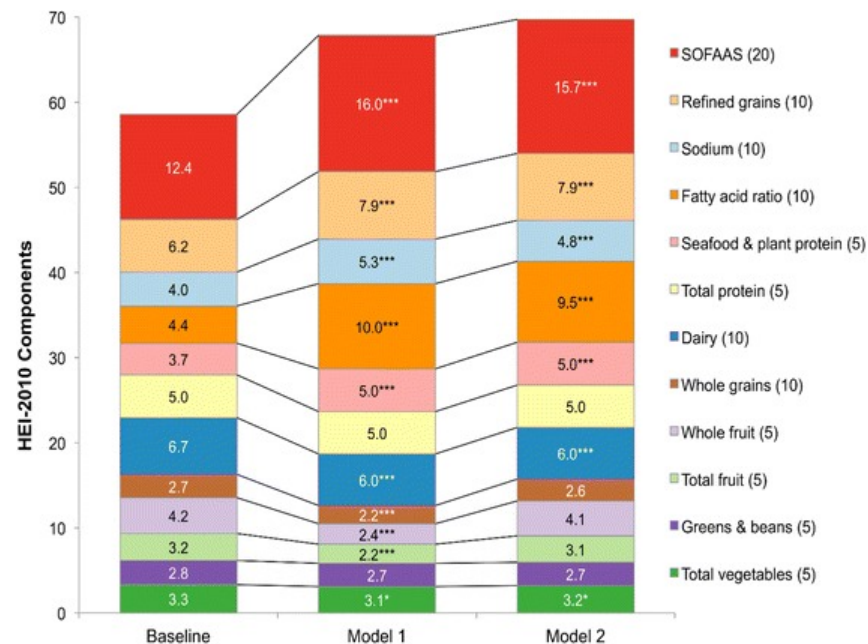
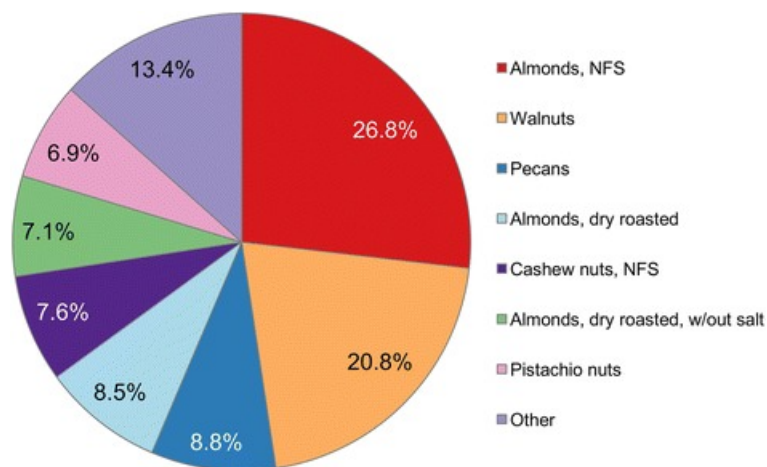
Replacing American snacks with tree nuts increases consumption of key nutrients among US children and adults: results of an NHANES modeling study

Colin D. Rehm  and Adam Drewnowski

Nutrition Journal 2017 16:17

<https://doi.org/10.1186/s12937-017-0238-5> | © The Author(s). 2017

Received: 8 August 2016 | Accepted: 28 February 2017 | Published: 7 March 2017



Replacing American Breakfast Foods with Ready-To-Eat (RTE) Cereals Increases Consumption of Key Food Groups and Nutrients among US Children and Adults: Results of an NHANES Modeling Study

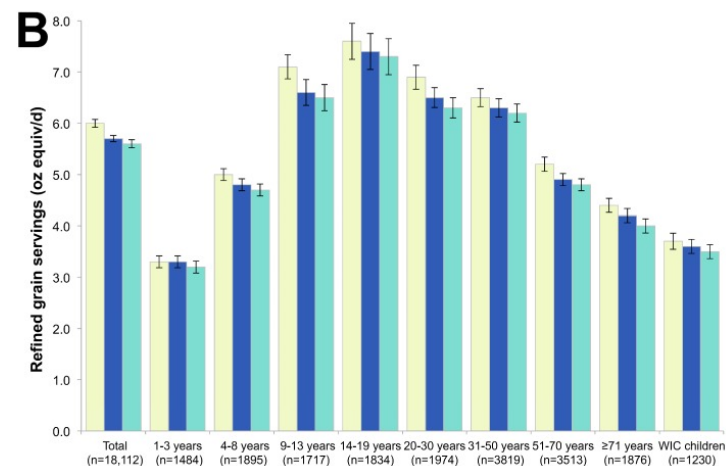
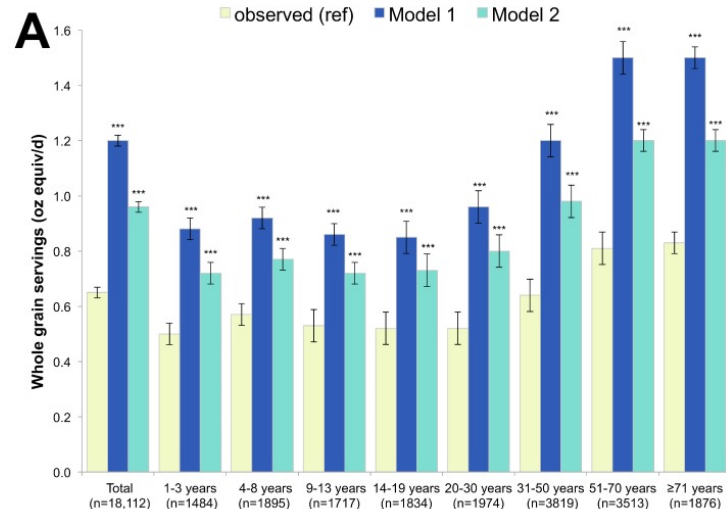
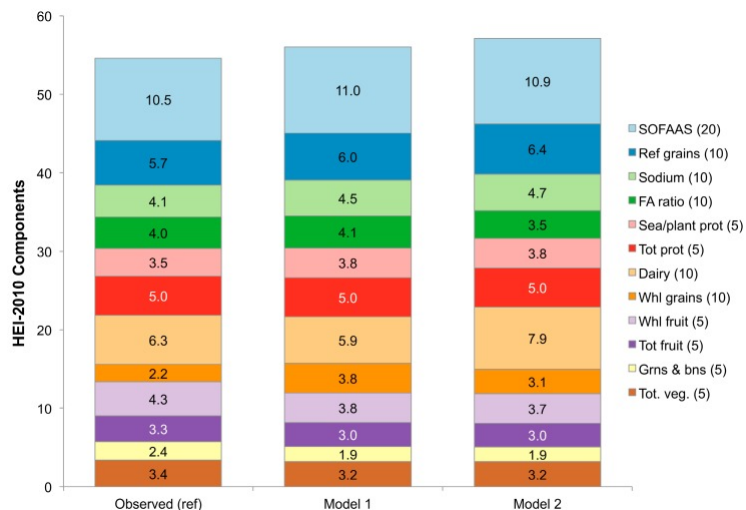
Colin D. Rehm  and Adam Drewnowski* 

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Nutrients **2017**, *9*(9), 1010; <https://doi.org/10.3390/nu9091010>

Received: 4 August 2017 / Revised: 1 September 2017 / Accepted: 11 September 2017 / Published: 13 September 2017



Replace milk with plant milk: a hot topic

GOT BOOBS? —

“An almond doesn’t lactate”—FDA to crack down on use of the word “milk”

FDA head says current products don't meet labeling standards, guidance coming soon.

BETH MOLE - 7/18/2018, 2:32 PM

FDA commissioner: ‘An almond doesn’t lactate... we have a standard of identity for milk and I intend to enforce that’

By Elaine Watson

18-Jul-2018 - Last updated on 18-Jul-2018 at 04:54 GMT

3 COMMENTS

'An Almond Doesn't Lactate'

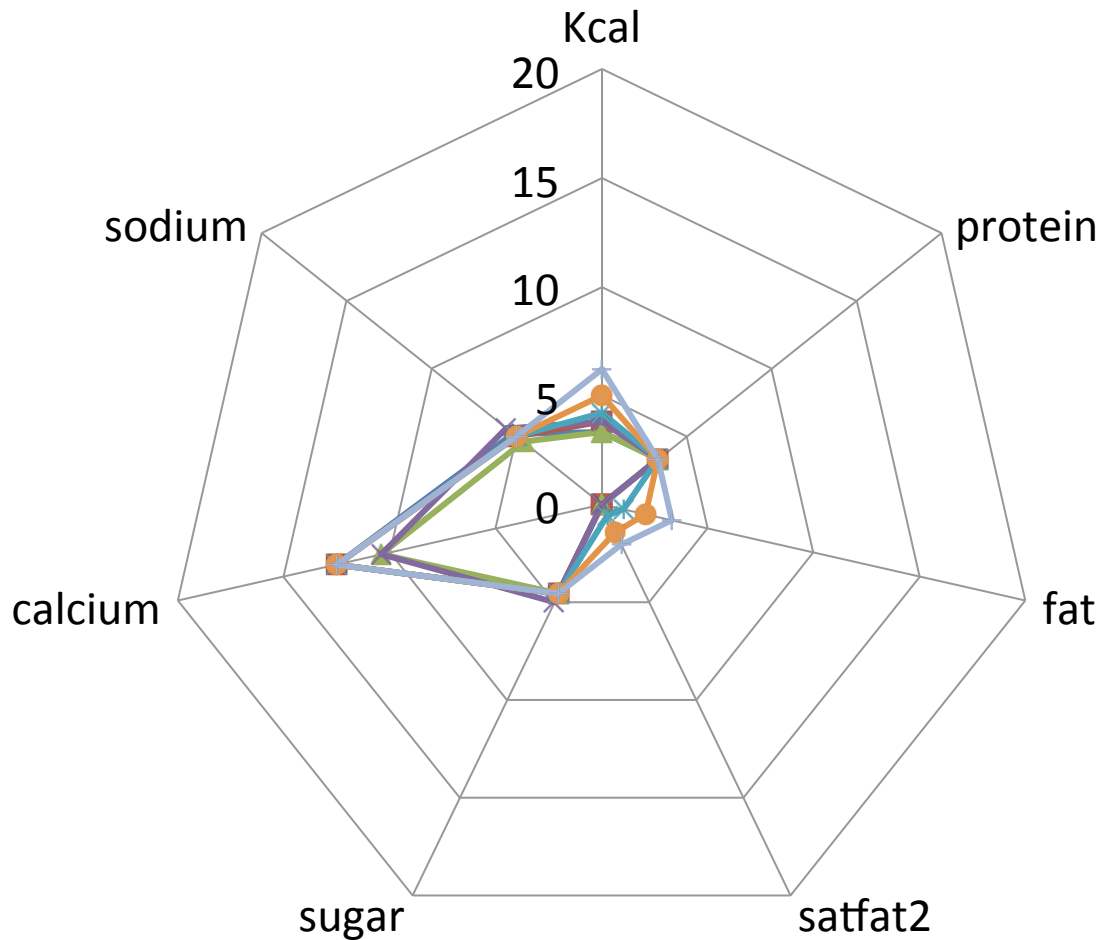
The coming war over nut milks

Mike Riggs from the November 2018 issue - view article in the Digital Edition



The increasing availability of plant-based alternatives to products a blessing for vegans, vegetarians, and others who—for reasons based far. If milk makes you gassy, you can buy a white, milk-like coconuts. If you love the texture of beef but not the idea of eating with a meaty texture that bleed beet juice.





- milk skim whole foods
- milk skim harris teeter
- ▲— milk skim food city
- ×— milk, skim target
- ※— milk 1% low fat supervalu
- milk 2% target
- +— milk whole, target

Nutrition Facts	
Serving Size 1 Cup (250ml)	
Servings Per Container Approx. 8	
Amount Per Serving	
Calories 110	Calories from Fat 25
% Daily Value*	
Total Fat 2.5g	4%
Saturated Fat 1.5g	8%
Cholesterol 15mg	5%
Sodium 115mg	5%
Total Carbohydrate 13g	4%
Sugars 13g	
Protein 9g	
Vitamin A 2%	• Calcium 30%
Not a significant source of trans fat, dietary fiber, vitamin C and iron.	
*Percent Daily Values are based on a 2,000 calorie diet.	

Nutrition Facts

Serving Size: 8 Fl.oz. (238g)

Servings Per Container: 4

Amount Per Serving

Calories 105 Calories from Fat 3

% Daily Value *

Total Fat 0g 0%

Cholesterol 0g 0%

Sodium 47mg 2%

Total Carbohydrates 20g 7%

Dietary Fiber 1g 3%

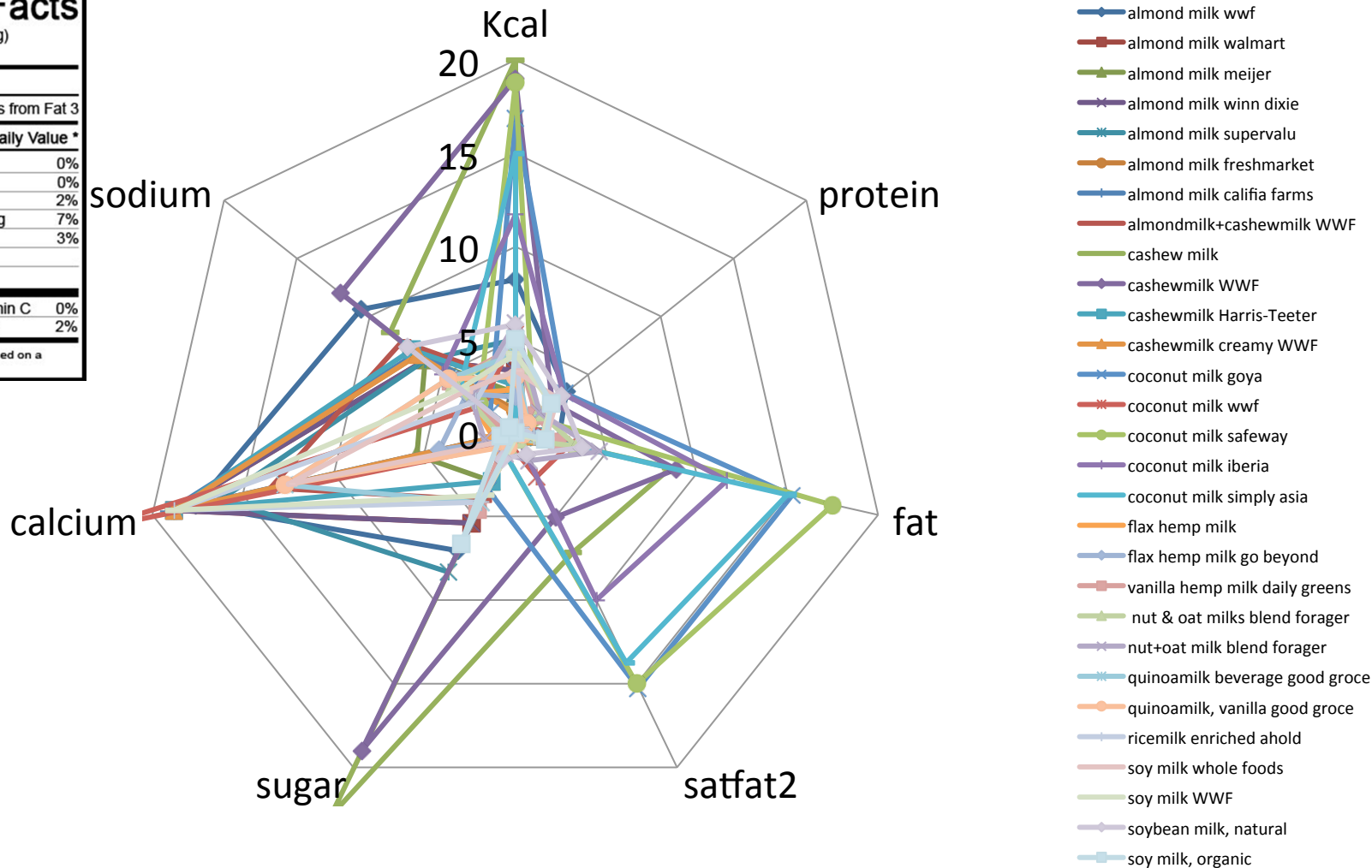
Sugars 16g

Protein 1g

Vitamin A 0% * Vitamin C 0%

Calcium 1% * Iron 2%

* Percent Daily Values are based on a
2,000 calorie diet.



Nutrient substitution models

- Replace “bad” nutrients with “good” nutrients
 - Take a large observational cohort: 5,158,337 person years of follow up. Very impressive.
 - Model the exchanging of good and bad dietary fats.
 - Replace “bad” dairy fat with vegetable fats and PUFA.
 - Switch regression coefficients to model reduced CVD risk, and claim health benefits.
- Not so fast.



Over-reliance on regression models

- Substitution effects of substituting dairy fat with other sources of energy were estimated by the *difference in the coefficients* between fat sources and their covariances with the use of a time-dependent Cox proportional hazard regression model adjusted for age (continuous), BMI (8 categories), total energy intake (quintiles), race, smoking, physical activity, alcohol consumption, menopausal status and menopausal hormone use (NHS and NHS II participants only), oral contraceptive use (NHS II participants only), baseline hypertension, and baseline hypercholesterolemia, and dietary intakes of fruit, vegetables, coffee, and protein.
- So what. Switch adjusted coefficients; save lives.

Food-level nutrient substitution models

- Reducing 5% dietary energy from dairy fat means reducing milk, yogurt, cheese, and many mixed foods.
- In practice, a 5% energy reduction means removing dairy products altogether.
- Dairy fits into multiple food patterns that vary by age, gender, income, and race/ethnicity.
- PUFA sources are not the same for everyone.
- We need to do a food-level substitution for dairy and PUFA sources that is food-pattern specific (age, gender, kcal, ED).

What happens when dairy fat is removed?

N=15,260	Observed	Model 1 (remove all)	Model 2 (remove 5%)
Energy, kcal	2080 (2055, 2105)	1454 (1435, 1474)***	1580 (1558, 1601)***
Protein, %E	15.8 (15.5, 16)	14.2 (13.9, 14.5)	14.7 (14.4, 15)
Saturated fat, %E	11.4 (11.2, 11.5)	8.7 (8.6, 8.9)***	9.6 (9.4, 9.7)***
PUFA, %E	8.0 (7.9, 8.1)	8.3 (8.2, 8.5)	8.2 (8.1, 8.4)
MUFA, %E	12 (11.9, 12.1)	11.4 (11.2, 11.5)	11.6 (11.4, 11.7)
Dairy fat, %E	5.6 (5.4, 5.8)	0 (0, 0)***	1.7 (1.6, 1.9)***
Added sugar, %E	13.4 (13.1, 13.8)	16 (15.5, 16.4)***	15.2 (14.8, 15.6)***
Calcium, mg	965 (949, 981)	715 (700, 730)***	784 (772, 796)***
Vitamin D, mcg	4.8 (4.7, 5)	2.7 (2.5, 2.9)***	3.4 (3.2, 3.6)***
Vitamin A, mcg	637 (618, 656)	490 (465, 516)***	531 (510, 553)***
Riboflavin, mg	2.1 (2.1, 2.1)	1.8 (1.7, 1.9)**	1.9 (1.8, 1.9)*
Niacin, mg	25.1 (24.8, 25.4)	25.8 (25.2, 26.3)	25.6 (25.1, 26)
Vitamin B12, mcg	4.8 (4.7, 4.9)	3.6 (3.5, 3.7)***	4 (3.9, 4.1)***

^a Model 1 removes all dairy fat. Model 2 removes up to 5% dairy fat for each individual; ^b.



Articles

Global and regional health effects of future food production under climate change: a modelling study

Dr Marco Springmann PhD^a, Daniel Mason-D'Croz MA^a, Sherman Robinson PhD^a, Tara Garnett PhD^b, Prof H Charles J Godfray PhD^c, Prof Douglas Gollin PhD^d, Prof Mike Rayner DPhil^a, Paola Ballon PhD^d, Peter Scarborough DPhil^a

Show more



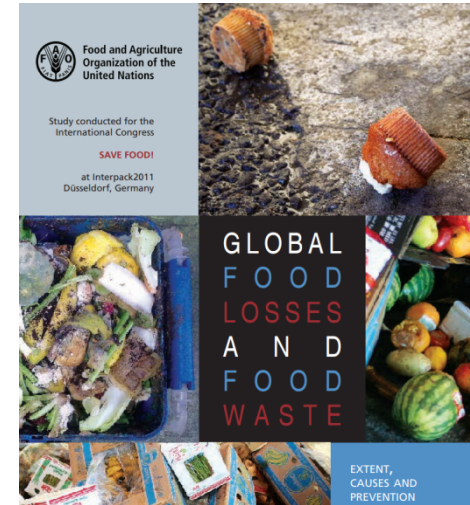
Food in the Anthropocene: the EAT–Lancet Commission on healthy diets from sustainable food systems



“Food in the Anthropocene represents one of the greatest health and environmental challenges of the 21st century.”


How Lancet sausage is made

- We converted the food availability estimates for fruit and vegetables and for red meat into food consumption estimates by using regional data about food waste, combined with conversion factors into edible matter.
 - J Gustavsson, C Cederberg, U Sonesson, R Van Otterdijk, A Meybeck Global food losses and food waste: extent, causes and prevention, FAO, Rome (2011)
- We linked food supply to body weight by pairing FAO food balance sheets for the years 1980–2009 with WHO data on BMI, using a polynomial trend.
- The diet and weight-related relative risk parameters were obtained from pooled analyses of prospective cohort studies (23, 24) and from meta-analyses of prospective cohort and case-control studies.(18-22)
 - A Berrington de Gonzalez, P Hartge, JR Cerhan, et al. Body-mass index and mortality among 1.46 million white adults
 - L Dauchet, P Amouyel, S Hercberg, J Dallongeville Fruit and vegetable consumption and risk of coronary heart disease: a meta-analysis of cohort studies



Emergency rations: grains, oil, sugar:

Good or bad?



S.O.S. EMERGENCY FOOD RATION

Life Saving Craft

SOLAS 174 - IMO LSA/MS C 218 (82)

Lloyd's Register: SAS S090179, MCA 0950042 (UK)

USCG No. 60.046/25/0 - TC 168.006.009

CONTENTS: Each packet of 6 fortified food bars provides 2400 Kcal (10,322kJ). Offers maximum survival capacity with drinking water restriction under all environmental conditions.

DIRECTIONS: Eat two food bars per person per day. 2400
Replace within 5 years of manufacturing date.

Nutrition Facts		Amount/Serving		% Daily Value*																												
<p>Serving Size 1 cookie (84g)</p> <p>Servings Per Container 6</p> <p>Calories 410</p> <p>Calories from Fat 160</p>	Total Fat 18g	26%	Total Carbohydrate 53g	18%	<p>*Percent Daily Values are based on a 2,000 calorie diet. Your daily values may be higher or lower depending on your calorie needs:</p> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th></th> <th>Calories: 2,000</th> <th>2,500</th> </tr> </thead> <tbody> <tr> <td>Total Fat</td> <td>Less than 65g</td> <td>80g</td> </tr> <tr> <td>Sat Fat</td> <td>Less than 20g</td> <td>25g</td> </tr> <tr> <td>Cholesterol</td> <td>Less than 300mg</td> <td>300mg</td> </tr> <tr> <td>Sodium</td> <td>Less than 2,400mg</td> <td>2,400mg</td> </tr> <tr> <td>Total Carbohydrate</td> <td>Less than 300g</td> <td>375g</td> </tr> <tr> <td>Dietary Fiber</td> <td>25g</td> <td>30g</td> </tr> <tr> <td colspan="3">Calories from Fat: 160g</td> </tr> <tr> <td colspan="3">Vitamin A 6% • Vitamin C 15% • Calcium 2% • Iron 8% • Vitamin E 1% • Vitamin K 1% • Protein 4%</td> </tr> </tbody> </table>		Calories: 2,000	2,500	Total Fat	Less than 65g	80g	Sat Fat	Less than 20g	25g	Cholesterol	Less than 300mg	300mg	Sodium	Less than 2,400mg	2,400mg	Total Carbohydrate	Less than 300g	375g	Dietary Fiber	25g	30g	Calories from Fat: 160g			Vitamin A 6% • Vitamin C 15% • Calcium 2% • Iron 8% • Vitamin E 1% • Vitamin K 1% • Protein 4%		
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Saturated Fat 7g	35%	Dietary Fiber 1g	5%																													
Trans Fat 3.5g		Sugars 31g																														
Cholesterol 0mg	0%	Protein 8g																														
Sodium 15mg	1%																															
Vitamin A 6%		Calcium 2%																														
Vitamin C 15%		Iron 8%																														

INGREDIENTS: Sugar, Enriched Wheat Flour, Partially Hydrogenated Vegetable Shortening (Soybean & Cottonseed Oils), Corn Starch, Wheat Gluten, Dextrose, Desiccated Coconut preserved with Sodium Metabisulfite, Corn Syrup, Contains less than 2% of each of the following: Propionic Preservative, Citric Acid, Salt, Soy Lecithin, Guar Gum, Calcium Propionate, Nicotinamide, Vitamin A Palmitate, Riboflavin, Ascorbic Acid, Ascorbyl Palmitate, Thiamine Mononitrate.

Net wt: 17.7 oz (502g)

Emergency food ration		Chile Art 2o
Energy	488 kcal	<350 kcal
Sat fat	8.3 g	<6 g
Sugar	37 g	22.5 g
Sodium	18 mg	800 mg



Final observation: Nothing stays still



SHARE

RESEARCH ARTICLE | ECOLOGY



Carbon dioxide (CO₂) levels this century will alter the protein, micronutrients, and vitamin content of rice grains with potential health consequences for the poorest rice-dependent countries

Chunwu Zhu¹, Kazuhiko Kobayashi², Irakli Loladze³, Jianguo Zhu¹, Qian Jiang¹, Xi Xu¹, Gang Liu¹, Saman Seneweera⁴, Kristie L. Ebi⁵, Adam Drewnowski⁶, Naomi K. Fukagawa⁷ and Lewis H. Ziska^{8,*}

¹State Key Laboratory of Soil and Sustainable Agriculture, Institute of Soil Science, Chinese Academy of Sciences, Nanjing 210008, P. R. China.

²University of Tokyo, 1-1-1 Yayoi, Bunkyo-ku, Tokyo 113-8657, Japan.

³Bryan College of Health Sciences, Bryan Medical Center, Lincoln, NE 68506, USA.

⁴Centre for Crop Health, University of Southern Queensland, Toowoomba, Queensland 4350, Australia.

⁵Center for Health and the Global Environment (CHaGE), University of Washington, Seattle, WA 98198, USA.

⁶Center for Public Health Nutrition, University of Washington, Seattle, WA 98195, USA.

⁷U.S. Department of Agriculture–Agricultural Research Service (USDA-ARS), Beltsville Human Nutrition Center, Beltsville, MD 20705, USA.

⁸USDA-ARS, Adaptive Cropping Systems Laboratory, Beltsville, MD 20705, USA.

*Corresponding author. Email: l.ziska@ars.usda.gov

– Hide authors and affiliations

- Nothing stands still.
- Countries will not stay poor or rice dependent for long.
- Nutrition transition is well under way
- Soon, LMIC will be eating less rice, and more chicken and more dairy.



INDUSTRY PREVIEW

Vietnam Dairy Market 2018

NIKKEI Quick



FiinPro BiinForm

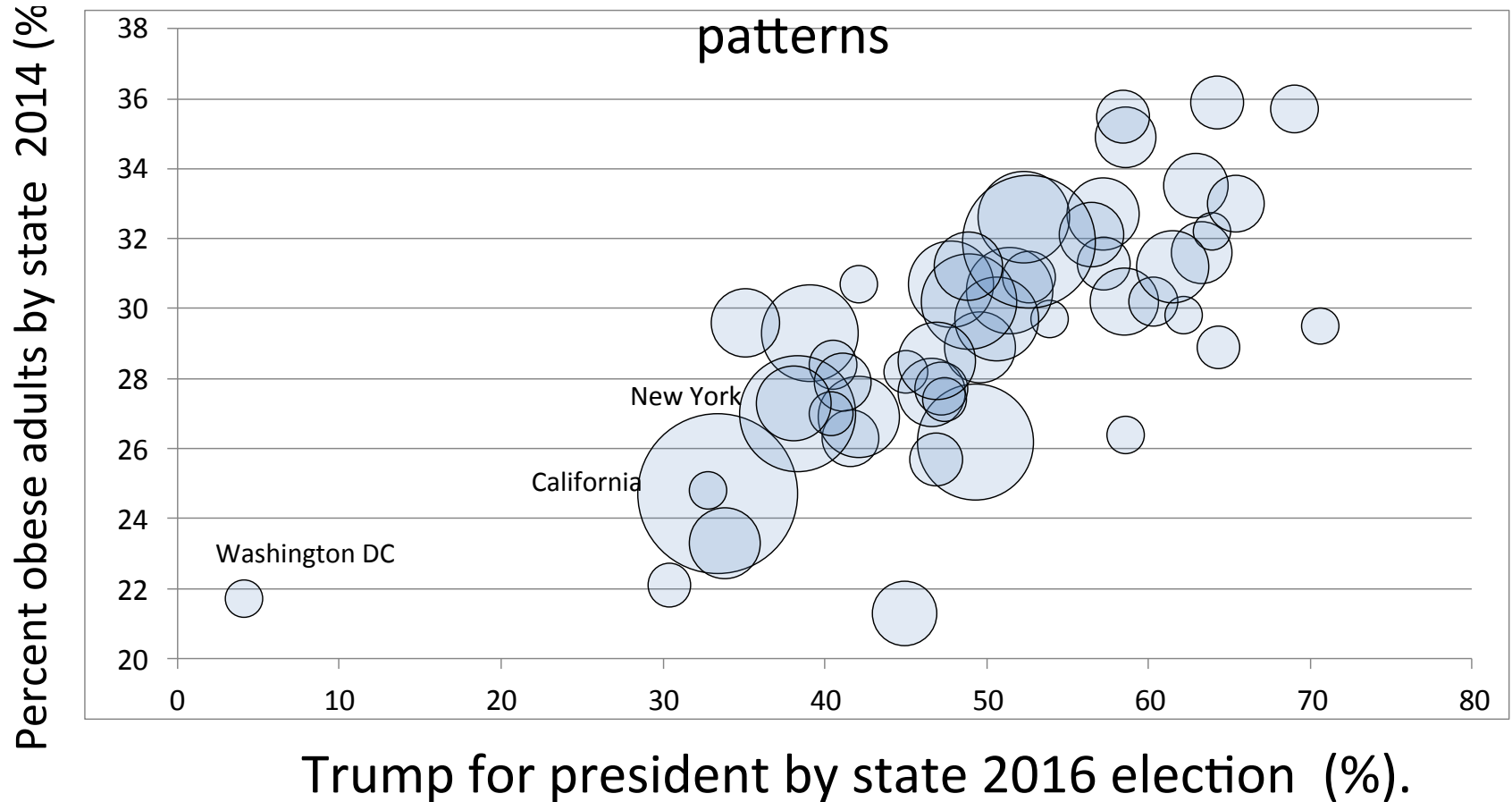
www.stoxplus.com | www.firpro.com | www.biinform.com

Health modeling: The future

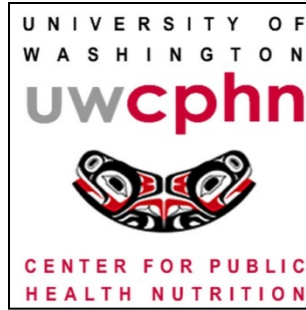
Health is always the modeling outcome.

What if health were only the beginning?
Can health be used to model and predict other
outcomes?

Health as predictor of behavior: 2016 US voting patterns



Size of the bubble denotes electoral votes by state. Election results 2016 from ballotpedia.org. Percent obese by state 2014 from Centers for Disease Control.



Thank you

Follow twitter: DrAdamDrew

How to measure *nutrient* density?

Commentary

Concept of a nutritious food: toward a nutrient density score¹⁻³

Adam Drewnowski

ABSTRACT

The American diet is said to be increasingly energy-rich but nutrient-poor. To help improve the nutrient-to-energy ratio, the 2005 *Dietary Guidelines for Americans* recommend that consumers replace some foods in their diets with more nutrient-dense options. Such dietary

Energy-dense sweets and fats have long been contrasted, unfavorably, to foods that contained substantial amounts of key nutrients per serving or per unit weight. The terms *energy-dense* and *nutrient-poor* are commonly used to characterize foods perceived as unhealthy and to distinguish them from more nutritious

Proceedings of the Nutrition Society (2017), 76, 220–229
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doi:10.1017/S0029665117000416

Nutrition Society Summer Meeting 2016 held at University College Dublin on 11–14 July 2016

Conference on ‘New technology in nutrition research and practice’ Nutrient profiling as a tool to respond to public health needs

Uses of nutrient profiling to address public health needs: from regulation to reformulation

Adam Drewnowski

Center for Public Health Nutrition, University of Washington, Seattle, WA, USA

Special Article

Nutrient profiling of foods: creating a nutrient-rich food index

Adam Drewnowski and Victor Fulgoni III

Nutrient profiling of foods, described as the science of ranking foods based on their nutrient content, is fast becoming the basis for regulating nutrition labels, health claims, and marketing and advertising to children. A number of nutrient profile models have now been developed by research scientists, regulatory agencies, and by the food industry. Whereas some of these models have focused on nutrients to limit, others have emphasized nutrients known to be beneficial to health, or some combination of both. Although nutrient profile models are often tailored to specific goals, the development process ought to follow the same science-driven rules. These include the selection of index nutrients and reference amount, an appropriate algorithm for calculating nutrient density, a chosen nutrient profile model against healthy diets. It is expected that nutrient profiles be validated rather than merely compared to opinion. Regulatory agencies should act only when they are confident that the scientific process has been followed, that the algorithms are transparent, and that the profile model has been validated with respect to objective measures of health.

© 2008 International Life Sciences Institute

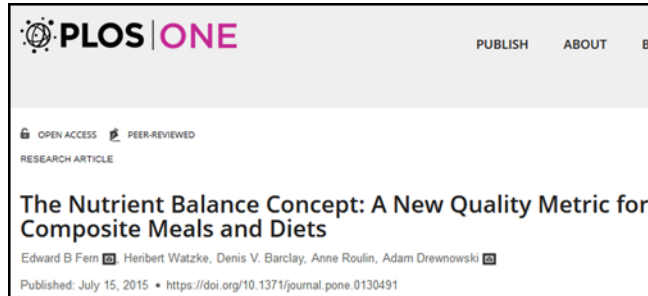
The Nutrient Rich Foods Index helps to identify healthy, affordable foods¹⁻⁴

Adam Drewnowski

ABSTRACT

Background: The Nutrient Rich Foods (NRF) Index is a formal scoring system that ranks foods on the basis of their nutrient con-

tent. Higher consumption of foods and nutrients to encourage, higher Healthy Eating Index values, and lower energy intakes overall (4). The documented links between nutrient-rich foods, overall



Nutrients 2019, 11(2), 379; <https://doi.org/10.3390/nu11020379>

Open Access Article

Personalized Nutrient Profiling of Food Patterns: Nestlé’s Nutrition Algorithm Applied to Dietary Intakes from NHANES

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