Dietary and Policy Priorities for Healthy Living

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Dean, Friedman School of Nutrition Science & Policy

Friedman School Webinar
Feb 12, 2015
The State of U.S. Health, 2010

Risk Factors

- Dietary risks
- Tobacco smoking
- High blood pressure
- High body mass index
- Physical inactivity and low physical activity
- High fasting plasma glucose
- High total cholesterol
- Ambient particulate matter pollution
- Alcohol use
- Drug use
- Lead exposure
- Occupational risks
- Low bone mineral density
- Residential radon
- Ambient ozone pollution
- Intimate partner violence
- Childhood sexual abuse

US Burden of Disease Collaborators, JAMA 2013
Diet & The Heart: Conventional Wisdom

Total Fat, Saturated Fat → Serum Total and LDL Cholesterol → Coronary Heart Disease

Ecologic Studies  Biomarker Studies  Animal Experiments
Diet & Obesity/Diabetes: Conventional Wisdom

Energy Out (Expenditure) → Adiposity → Type 2 Diabetes Mellitus

Energy In (Intake) → Adiposity

Total Fat Energy Density

Added Sugars

“Calories In, Calories Out'
Advances in Nutritional Science

Randomized Trials of Disease Outcomes

Prospective Cohorts of Disease Outcomes

Randomized Trials of Physiologic Measures / Risk Factors

Retrospective Case-Control Studies of Disease Outcomes

Animal Studies

Ecologic Studies

Prevalence Studies

Harris, Mozaffarian et al., J Nutrition 2009
Diet & The Heart: Modern Science

Mozaffarian D. *Braunwald's Heart Disease; A Textbook of Cardiovascular Medicine, 9th Edition*. 2011
Diet & Obesity/Diabetes: Modern Science

Energy In (Intake) → Adiposity

Energy Out (Expenditure) → Adiposity → Type 2 Diabetes Mellitus

Foods / Diet Quality:
- Carbohydrate Quality
- Nuts, Fruits, Vegetables, Dairy, Meats
- Specific Fats and Oils
- Overall Diet Patterns
Preventing Chronic Diseases: Food Patterns
<table>
<thead>
<tr>
<th>EAT:</th>
<th>LIMIT:</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Fruits</td>
<td>• Refined Grains, Starches, Sugars</td>
</tr>
<tr>
<td>• Nuts, Seeds</td>
<td>• Processed Meats</td>
</tr>
<tr>
<td>• Fish, Seafood</td>
<td>• Sweetened Drinks</td>
</tr>
<tr>
<td>• Vegetables</td>
<td>• Industrial Trans Fat</td>
</tr>
<tr>
<td>• Vegetable Oils*</td>
<td>• Salt</td>
</tr>
<tr>
<td>• Whole Grains</td>
<td>• Alcohol</td>
</tr>
<tr>
<td>• Moderate Dairy†</td>
<td></td>
</tr>
</tbody>
</table>

*Especially soybean oil and extra-virgin olive oil.
† Especially yogurt and cheese.
Why Our Infatuation with Single Nutrients?

- In 1753, James Lind tested whether eating citrus fruits prevented scurvy.

- In 1932, Vitamin C isolated, confirmed as the active protective nutrient. One nutrient → one disease!

- Soon: Thiamine (beriberi), niacin (pellagra), iron (anemia), iodine (goiter), vitamin A (night blindness), vitamin D (rickets).

- Early 20th century dietary guidelines thus focused on preventing nutrient deficiency diseases. Great Depression and World War II food shortages → further emphasis.

- The League of Nations, British Medical Association, and USDA formed panels to create new minimum requirements for calories, protein, calcium, phosphorus, iron, and various vitamins → First RDAs in 1941.

- Modern dietary guidelines were developed to meet these new RDAs. Set precedent to start with nutrient targets and then translate these into food recommendations.

Mozaffarian & Ludwig. JAMA 2010
Focus on Isolated Nutrients: A Useful Approach?

- Confusing and impractical.
- Results in illogical, poor dietary decisions:

  ![Light Summer Fruits Bars](image1)
  ![Hot Dog](image2)
  ![Avocado](image3)
  ![Nuts](image4)

- Distracts from what's truly important:

  **Overall dietary quality**

Mozaffarian & Ludwig. JAMA 2010
US Food Sources of Saturated Fat

Nutrient Focus: Ineffective, Illogical

Source: NHANES 2005-06
## Nutrient Focus: Recipe for Confusion

<table>
<thead>
<tr>
<th>Food Group</th>
<th>GO (Almost Anytime Foods)</th>
<th>SLOW (Sometimes Foods)</th>
<th>WHOA (Once in a While Foods)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vegetables</td>
<td>Almost all fresh, frozen, and canned vegetables without added fat and sauces</td>
<td>All vegetables with added fat and sauces; oven-baked French fries; avocado</td>
<td>Fried potatoes, like French fries or hash browns; other deep-fried vegetables</td>
</tr>
<tr>
<td>Meats, Poultry, Fish, Eggs, Beans, and Nuts</td>
<td>Trimmed beef and pork, extra lean ground beef; chicken and turkey without skin; tuna canned in water; baked, broiled, steamed, grilled fish and shellfish; beans, split peas, lentils, tofu; egg whites and egg substitutes</td>
<td>Lean ground beef, broiled hamburgers; ham, Canadian bacon; chicken and turkey with skin; low-fat hot dogs; tuna canned in oil; peanut butter; nuts; whole eggs cooked without added fat</td>
<td>Untrimmed beef and pork; regular ground beef; fried hamburgers; ribs; bacon; fried chicken, chicken nuggets; hot dogs, lunch meats, pepperoni, sausage; fried fish and shellfish; whole eggs cooked with fat</td>
</tr>
<tr>
<td>Sweets and Snacks*</td>
<td>Ice milk bars; frozen fruit juice bars; low-fat or fat-free frozen yogurt and ice cream; fig bars, ginger snaps, baked chips; low-fat microwave popcorn; pretzels</td>
<td>Cookies and cakes; pies; cheese cake; ice cream; chocolate; candy; chips; buttered microwave popcorn</td>
<td></td>
</tr>
<tr>
<td>Fats/Condiments</td>
<td>Vinegar; ketchup; mustard; fat-free creamy salad dressing; fat-free mayonnaise; fat-free sour cream</td>
<td>Vegetable oil, olive oil, and oil-based salad dressing; soft margarine; low-fat creamy salad dressing; low-fat mayonnaise; low-fat sour cream**</td>
<td>Butter, stick margarine; lard; salt pork; gravy; regular creamy salad dressing; mayonnaise; tartar sauce; sour cream; cheese sauce; cream sauce; cream cheese dips</td>
</tr>
<tr>
<td>Beverages</td>
<td>Water, fat-free milk, or 1 percent low-fat milk; diet soda; unsweetened ice tea or diet iced tea and lemonade</td>
<td>2 percent low-fat milk; 100 percent fruit juice; sports drinks</td>
<td>Whole milk; regular soda; calorically sweetened iced teas and lemonade; fruit drinks with less than 100 percent fruit juice</td>
</tr>
</tbody>
</table>

Nutrient Focus: Recipe for Manipulation

- Low calorie = “Less weight gain”
- Fat free = “Healthy"
- Low saturated fat = "Healthy"
Nutrient Focus: Recipe for Manipulation

- Fortified = "Healthy"
- Vitamins = "Healthy"
Calories (or Single Nutrients): Misleading
Preventing Chronic Diseases: Food Patterns
Benefit

Fruits, Nuts, Fish
Vegetable Oils, Vegetables
Whole Grains, Beans, Yogurt
Cheese
Eggs, Poultry, Milk
Unprocessed Red Meat

Harm

Refined Grains, Starches, Sugars
Processed Meats, High Sodium Foods
Industrial Trans Fat
Nutrition Science: Major Unanswered Questions

• Carbohydrate quality.
  – metrics, mechanisms.

• Biology of weight gain.
  – liver metabolism, insulin, leptin/ghrelin, brain reward, adipocyte function, brown fat.

• Dairy and metabolic health.
  – yogurt, cheese, dairy fat, milk.

• Phytochemicals, trace nutrients.
  – flavonoids, phenolics (epicatechin, oleocanthal).

• Microbiome (gut bacteria).
  – foods, mechanisms, interactions.

• Brain health
  – long-term effects of most foods, nutrients.
Nutrition Science: Major Unanswered Questions

• **Fatty acids**
  – specific individual fats (e.g. ALA, DPA, med-chain saturated), ceramides, sphingomyelins.

• **Food systems, sustainability.**
  – local, regional, global systems; climate change, land, water, human resources.

• **Food security, humanitarian crises.**
  – biofortification, equity, delivery science.

• **Policy science, economic impact.**
  – evidence-based, cost-effective strategies.

• **Implementation, evaluation.**
  – public-private partnerships, incentives, robust design, impact.
Sources of Calories in the US Diet

- Other carbs
- Whole grain
- Potatoes
- Refined grain
- Added sugar
- Sat fat
- Mono fat
- Poly fat
- Protein
- Trans fat
Carbohydrate Quality: Challenging to Define Simply

- Fiber content
- Glycemic response
- Liquid vs. solid
- Whole grain content

Mozaffarian D. Curr Athero Reports 2005
Choosing Carbs: Best Rule of Thumb?

- **Conflicting recommended metrics:**
  - Industry-sponsored “whole grain stamp”.
  - Three USDA-recommended definitions, each based on the ingredients list.
  - Ratio of total carb to fiber per serving (AHA 2020 Goals).

- **Best metric: Ratio of total carb to fiber**
  
  - $> 10:1$  =  Avoid
  - $< 10:1$  =  A good choice (many options)
  - $< 5:1$  =  A great choice (fewer options)

Mozaffarian RS et al, Public Health Nutr 2013
Grains and Sugars: What’s the Healthy Choice?

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**Kellogg’s Corn Flakes®**

<table>
<thead>
<tr>
<th>Nutrition Facts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Serving Size: 1 Cup (28g/1.0 oz.)</td>
</tr>
<tr>
<td>Amount Per Serving: Cereal</td>
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<tr>
<td>Calories: 100</td>
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<tr>
<td>Calories from Fat: 0</td>
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<tr>
<td>% Daily Value**</td>
</tr>
<tr>
<td>Total Fat: 0g*</td>
</tr>
<tr>
<td>Saturated Fat: 0g</td>
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<td>Trans Fat: 0g</td>
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<tr>
<td>Cholesterol: 0mg</td>
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<tr>
<td>Sodium: 200mg</td>
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<tr>
<td>Potassium: 25mg</td>
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<tr>
<td>Total Carbohydrate: 24g</td>
</tr>
<tr>
<td>Dietary Fiber: 1g</td>
</tr>
<tr>
<td>Sugars: 2g</td>
</tr>
<tr>
<td>Protein: 2g</td>
</tr>
</tbody>
</table>

**Kashi® Good Friends®**

<table>
<thead>
<tr>
<th>Nutrition Facts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Serving Size: 1 Cup (53g/1.9 oz.)</td>
</tr>
<tr>
<td>Amount Per Serving: Nutritional Facts</td>
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<tr>
<td>Calories: 130</td>
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<tr>
<td>Calories from Fat: 15</td>
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<tr>
<td>% Daily Value*</td>
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<tr>
<td>Total Fat: 15g</td>
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<tr>
<td>Saturated Fat: 0g</td>
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<tr>
<td>Trans Fat: 0g</td>
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<td>Cholesterol: 0mg</td>
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<td>Sodium: 110mg</td>
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<td>Potassium: 150mg</td>
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<td>Total Carbohydrate: 42g</td>
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<tr>
<td>Dietary Fiber: 12g</td>
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<tr>
<td>Soluble Fiber: 1g</td>
</tr>
<tr>
<td>Insoluble Fiber: 11g</td>
</tr>
<tr>
<td>Sugars: 10g</td>
</tr>
<tr>
<td>Protein: 5g</td>
</tr>
</tbody>
</table>

**Kashi® Soft-Baked Cookies Oatmeal Raisin Flax**

<table>
<thead>
<tr>
<th>Nutrition Facts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Serving Size: 1 Cookie (30g)</td>
</tr>
<tr>
<td>Amount Per Serving: Nutritional Facts</td>
</tr>
<tr>
<td>Calories: 120</td>
</tr>
<tr>
<td>Calories from Fat: 40</td>
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<tr>
<td>% Daily Value*</td>
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<tr>
<td>Total Fat: 4.5g</td>
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<tr>
<td>Saturated Fat: 0g</td>
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<tr>
<td>Trans Fat: 0g</td>
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<tr>
<td>Cholesterol: 0mg</td>
</tr>
<tr>
<td>Sodium: 70mg</td>
</tr>
<tr>
<td>Total Carbohydrate: 20g</td>
</tr>
<tr>
<td>Dietary Fiber: 4g</td>
</tr>
<tr>
<td>Sugars: 7g</td>
</tr>
<tr>
<td>Protein: 2g</td>
</tr>
</tbody>
</table>

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**INGREDIENTS:** Milled corn, sugar, malt flavoring, high fructose corn syrup, salt, iron, niacinamide, sodium ascorbate and ascorbic acid (vitamin C), pyridoxine hydrochloride (vitamin B6), riboflavin (vitamin B2), thiamin hydrochloride (vitamin B1), vitamin A palmitate, folic acid, vitamin B12 and vitamin D. To maintain quality, BHT is added to packaging.

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**INGREDIENTS:** Wheat bran, granola (whole grain oats, whole grain wheat, brown rice syrup, evaporated cane juice, crispy rice [rice flour, evaporated cane juice, malt extract, salt]), evaporated cane juice syrup, expeller pressed canola oil, waxy maize starch, salt, honey, natural flavors, mixed tocopherols (natural vitamin E added for freshness), evaporated cane juice syrup, yellow corn meal, corn flour, Kashi seven whole grains & Sesame® flour (whole grain oats, hard red wheat, rye, brown rice, triticale, barley, buckwheat, sesame seeds), corn bran, oat fiber, soy protein concentrate, expeller pressed canola oil, salt, natural flavors, annatto color.
Diet Quality and Obesity: 
All Calories are *Not* Created Equal

Complex influences of different foods on:

- Hunger, fullness
- Insulin, adrenalin, other hormonal responses
- Liver fat production (de novo lipogenesis, conversion of carbohydrate to fat)
- Brain reward
- Microbiome
- Metabolic expenditure (energy out)
Among 3,736 US adults, adjusted for age, sex, race, education, smoking, BMI, waist circumference, coronary heart disease, physical activity, alcohol use, and consumption of protein, carbohydrates, red meat, whole-fat dairy, low-fat dairy, and total energy.

Mozaffarian et al., Annals Intern Med 2010
Dairy fat: Turning off de novo lipogenesis (DNL)?

Could non-hepatic (external) 16:1n-7 suppress liver DNL and improve insulin sensitivity?

Fatty liver: A key driver of insulin resistance

- Greenberg et al., JCI 2011
- Mozaffarian et al., Ann Intern Med 2010
- Mozaffarian et al., AJCN 2013

Cao et al., Cell 2008
Dietary Policy: Directions and Priorities

• The leading cause of poor health.
  – Both death and disability.
  – Both in US and worldwide.

• The leading US economic issue.
  – Health care = 18% of GDP… nearly $1 in every $5.
  – Three trillion dollars ($3,000,000,000,000).
  – Diet-related illness is the #1 contributor.

• The leading cause of environmental impact.
  – Greenhouse gas emissions.
  – Water use, land use, deforestation.

• Yet, almost wholly ignored.
  – By health care system.
  – By policy makers (e.g., State of the Union).
Changing Behavior

• Individual level approaches
• Health care system strategies
• Policy (population) strategies
Health Care System Strategies

- Multiple education techniques, including live/media modes, to improve provider knowledge on and use of behavior change.

- Efficient electronic approaches for monitoring diet quality, physical activity, adiposity, and smoking.

- Regular scheduling for individual or group visits for education and behavioral support.

- Clinic, telephone, and electronic approaches for individualized feedback to patients on their behavior changes efforts.

- Restructuring of quality benchmarks and reimbursement guidelines to focus on health behaviors, including diet quality and physical activity.

Mozaffarian et al., Circulation 2012
Spring et al., Circulation 2013
Healthy Diet Policies: Barriers

• Incomplete policy maker knowledge on key dietary targets:
  – Current calorie/fat fetish: USDG, menu labeling, nutrition facts panel, school lunch program, etc.

• Insufficient use of the best evidence-based policies:
  – Most emphasis on knowledge alone: labeling, information, education, guidelines.
  – Little focus on other, complementary approaches.

• Opposition: food industry, hunger groups, the public.

• “Disease-treatment” health care system:
  – Diversion of both attention and resources.
Barriers and Opportunities for Healthy Eating

Afshin A et al, The Handbook for Global Health Policy
## Evidence-Based Policy Interventions for Diet

<table>
<thead>
<tr>
<th>Media and Education</th>
<th>Sustained, focused media campaigns, especially combined with multi-component strategies, focused on specific foods or drinks.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Labeling and Information</td>
<td>Mandated nutrition facts, front-of-pack labels/icons, or menu labeling to influence industry behavior and product formulations.</td>
</tr>
<tr>
<td>Schools</td>
<td>Multicomponent diet and activity program including classes, teacher training, supportive policies, environmental changes, family components.</td>
</tr>
<tr>
<td>Workplaces</td>
<td>Comprehensive worksite wellness programs for diet, activity, tobacco.</td>
</tr>
<tr>
<td>Workplaces</td>
<td>Increased availability of healthier options and/or strong nutrition standards, combined with on-site prompts, labels, or icons.</td>
</tr>
<tr>
<td>Economic Incentives</td>
<td>Subsidy strategies to lower prices of more healthful foods and beverages.</td>
</tr>
<tr>
<td>Economic Incentives</td>
<td>Tax strategies to increase prices of less healthful foods and beverages.</td>
</tr>
<tr>
<td>Economic Incentives</td>
<td>Long-term changes in agricultural and related policies for infrastructure to facilitate production, transportation, and marketing of healthier foods.</td>
</tr>
<tr>
<td>Bans and Mandates</td>
<td>Restrictions on ads/marketing of less healthy foods/drinks to children on television, and near schools and public places, and on packages.</td>
</tr>
<tr>
<td>Bans and Mandates</td>
<td>Direct bans (e.g., sodium, trans fat) or mandates (e.g., vegetable oils).</td>
</tr>
</tbody>
</table>

Mozaffarian et al, AHA Scientific Statement, Circulation 2012
## Several Diet Strategies with Less Evidence

<table>
<thead>
<tr>
<th>Media and Education</th>
<th>Shorter-term, community media/education efforts that target multiple CVD behaviors and risk factors simultaneously. (IIb B)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Labeling Information</td>
<td>Detailed nutrition facts panels, front of pack labels, or menu labelling as a means to influence consumer behavior. (III B)</td>
</tr>
<tr>
<td>Schools</td>
<td>School-based education alone, without other components. (IIb A)</td>
</tr>
<tr>
<td></td>
<td>Restricted access (times, locations) to vending machines. (IIb B)</td>
</tr>
<tr>
<td></td>
<td>Promotion of water use alone. (IIb B)</td>
</tr>
<tr>
<td>Workplaces</td>
<td>Worksite cafeteria or vending labels or prompts alone. (IIb B)</td>
</tr>
<tr>
<td>Economic Incentives</td>
<td>Crop subsidies alone (e.g., corn) to either encourage or reduce crops as a means to alter price or consumption. (IIb C)</td>
</tr>
</tbody>
</table>
## The Real Cost of Food – Dietary Taxes and Subsidies to Improve Public Health

<table>
<thead>
<tr>
<th></th>
<th>Packaged and supermarket foods</th>
<th>Restaurant and other food service establishments</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Simple Flat Tax (10-30%)</strong></td>
<td>Most packaged foods (e.g., nearly all foods with a label).</td>
<td>Most chain restaurants, large cafeteria vendors, and other similar food service establishments.</td>
</tr>
<tr>
<td><strong>Subsidy (from tax revenue)</strong></td>
<td>Minimally processed healthful foods, such as fruits, nuts, vegetables, beans, seafood, plain yogurt, vegetable oils, and minimally processed whole grains.</td>
<td>School lunch and afterschool programs.</td>
</tr>
</tbody>
</table>
Lessons From Past Public Health Successes

FIGURE 1. Motor-vehicle-related deaths per million vehicle miles traveled (VMT) and annual VMT, by year — United States, 1925–1997

US Centers for Disease Control and Prevention, 1999
Lessons From Past Public Health Successes

- **Driver:**
  - Education.
  - Licensing.
  - Limits on phone use, texting.

- **Car:**
  - Active: seat belts, child seats, motorcycle helmets.
  - Passive: padded interiors, collapsible steering columns, shatterproof glass, air bags.
  - Crash safety standards.
  - Safety inspections.

- **Road:**
  - Road engineering, guard rails, rumble strips.
  - Speed limits.
  - Stop signs, stop lights, caution signs.

- **Culture:**
  - Designated driver campaign.
  - Drunk-driving legislation.
  - Private advocacy, e.g. MADD.

Mozaffarian, Hemenway, & Ludwig, JAMA 2013
John Snow, London Cholera Epidemic, 1854

Further Information and Resources

• Friedman School of Nutrition Science & Policy  
  www.nutrition.tufts.edu
  – **Programs:** Agriculture, Food, and Environment; Biochemical & Molecular Nutrition; Food Policy & Applied Nutrition; Humanitarian Assistance; Nutrition Communication & Behavior Change; Nutritional Epidemiology; MS Dietetics Internship; MNSP Blended Learning.
  – **Child Obesity 180,** www.childobesity180.org/
  – **Feinstein International Center,** fic.tufts.edu/
  – **New Entry Sustainable Farming Project,** www.nesfp.org/
  – **Nutrition Innovation Lab,** www.nutritioninnovationlab.org/

• **Nutrition Magazine,** www.nutrition.tufts.edu/publications/magazine

• **Tufts Health & Nutrition Letter,** www.nutritionletter.tufts.edu