Title: Affordable Nutrition Index: Nutrient profiling of soups using Nutrient Rich Foods (NRF) Index and Food Price Data.
Authors: Adam Drewnowski and Colin Rehm.
Background: There is an increasing need to identify affordable nutrient-rich foods and food groups.
Methods: Nutrient density of individual foods and beverages was measured using Nutrient Rich Foods (NRF) indexes, calculated per 100 kcal and serving size (reference amounts customarily consumed [RACC]). The NRF9.3 index is based on 9 nutrients to encourage and 3 nutrients to limit. Nutrient composition data were obtained form the USDA Food and Nutrition Database for Dietary Studies and from industry sources. The NRF algorithm was applied to the USDA FNDDS 1.0 nutrient composition database merged with the USDA CNPP food prices database, both linked to the 2001-2 NHANES data. Additional nutrient composition data for soups were obtained from industry sources and recent prices for selected foods were obtained from 2008 survey of Seattle supermarkets. Calculations measured energy density (kcal/100g); nutrient density (NRF index), energy cost ($/1000 kcal) and affordable nutrition estimated by dividing NRF values by price per serving (NRF/$).
Results: Primary analyses evaluated median NRF and NPR scores by food groups using the CNPP prices. Comparisons between food groups found that some soups, chiefly tomato (NRF 100; NPR 170), had favorable scores when compared to fresh vegetables (NRF 43; NPR 149), raw tomatoes (NRF 38; NPR 127) and fresh fruit (NRF 62; NPR 166). Supplemental analyses with contemporary price data compared the NPR index for soups with vegetables, fruit, juices and other foods, with the goal of confirming the primary results using alternative price information.
Conclusions: The joining of nutrient profiling data and food prices provide a useful new tool for identifying affordable nutrient-rich foods and food groups. The goals of affordable nutrition are to provide consumers with optimum nutrition at an accessible cost.
Supported by Campbell Soup Co.

# Affordable Nutrition Index: Nutrient Profiling of Soups Using the Nutrient Rich Foods (NRF) Index and Food Prices Data

Adam Drewnowski, PhD & Colin Rehm, MPH
Center for Public Health Nutrition and the Center for Obesity Research, School of Public Health, University of Washington, Seattle, WA 98195

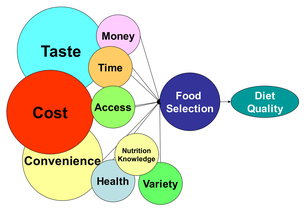
## Background

- For Americans, meeting the recommendations of the US Dietary Guidelines can be difficult in these economic times.
- Americans may be sacrificing healthful eating habits as they try to cut back on food spending.
- Multiple factors – including taste, nutrition, and food costs - drive food choice behavior at point of sale (1,2).
- Assessment of the nutritive value of different foods in relation to cost can help us identify foods that are both nutritious and affordable (1,2).
- Healthy choices need not be expensive if the concepts of the foods' nutrient density and value are identified and successfully conveyed to the consumer (2).

## Study Objectives

- Formal food rating systems, such as the Nutrient Rich Foods Index (NRF9.3), assign nutrient quality scores to foods, based on their nutrient composition.
- The NRF9.3 Index score takes into account the amounts per serving of 9 nutrients to encourage and 3 nutrients to limit: saturated fat, added sugar and sodium. (See figure below describing the NRF 9.3 Index)
- When divided by price per serving, the Nutrient Rich Foods Index becomes a new measure: The Affordable Nutrition Index (ANI).
- This new tool can be used to identify foods that are both nutritious and affordable.
- The present study objective was to compare ANI values of most Campbell's canned soups (regular and condensed) to those of selected vegetables, fruits, and snacks.

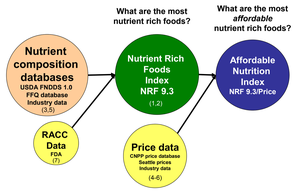
### Drivers of Food Choice Behavior




## Novel Methodology: A New Index of Affordable Nutrition

- The NRF 9.3 index was developed and validated (2) using the open source USDA FNDDS1.0 (3) nutrient composition database.
- The NRF formula was calculated as:
  - NRF 9.3 = sum of nutrients to encourage (% Daily Values) - sum of nutrients to limit (% Maximum Recommended Values).
  - Nutrients to encourage: Protein, fiber, vit A, C, E, Ca, Fe, K, Mg.
  - Nutrients to limit: saturated fat, added sugar, sodium.
  - All daily values calculated per serving size and capped at 100%.
  - Reference amounts for nutrients to encourage from Food and Drug Administration (7).
  - Maximum recommended values from nutrients to limit from IOM and WHO.
  - Serving sizes (RACC) from Food and Drug Administration (7).
  - Prices per serving obtained from the Center of Nutrition Policy and Promotion (CNPP) food prices database, Seattle supermarkets and industry sources (4-6).
- Dividing NRF 9.3 Index score by price per serving created a new Affordable Nutrition Index (ANI).
- ANI values (NRF points per dollar) allowed us to identify:
  - Most nutrient rich foods.
  - Most affordable nutrient rich foods.

### Creating the Affordable Nutrition Index (ANI)




### The Nutrient Rich Foods Index NRF 9.3

**Reference Daily Intake Values Provided For Each Nutrient (2)**

| 9 nutrients to encourage | | | 3 nutrients to limit |
|---|---|---|---|
| Protein 50g | Fiber 25g | Vit A 5000 IU | Saturated Fat 20g |
| Iron 18 mg | Calcium 1000 mg | Vit C 60 mg | Added Sugars 50g |
| Potassium 3500 mg | Magnesium 400 mg | Vit E 30 IU | Sodium 2400 mg |

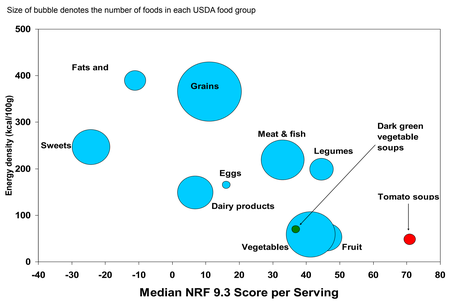
**Percent DVs calculated per FDA serving and capped at 100%DV**

### Affordable Nutrition Index:
**NRF 9.3 Per Serving Divided by Cost Per Serving**

| | Name | NRF 9.3 per Serving | Cost per Serving | Affordable Nutrition Index |
|---|---|---|---|---|
| 1. | Regular carrot | 69.0 | $0.17 | 404.0 |
| 2. | Baby carrot | 69.0 | $0.19 | 368.4 |
| 3. | Sweet potatoes, baked | 137.0 | $0.62 | 223.0 |
| 4. | Broccoli, cooked | 84.2 | $0.40 | 212.7 |
| 5. | **Campbell's® Healthy Request® Condensed Vegetable Soup** | 77.0 | $0.54 | 142.9 |
| 6. | Green pepper, raw | 118.3 | $0.95 | 124.8 |
| 7. | **Campbell's® Healthy Request® Condensed Vegetable Beef Soup** | 70.7 | $0.63 | 112.1 |
| 8. | **Campbell's® Chunky™ Old Fashioned Vegetable Beef Soup** | 118.4 | $1.05 | 111.3 |
| 9. | **Campbell's® Healthy Request® Condensed Minestrone Soup** | 63.4 | $0.58 | 109.9 |
| 10. | **Campbell's® Select Harvest® Savory White Bean with Roasted Ham Soup** | 112.8 | $1.04 | 108.0 |
| 11. | Winter squash | 57.6 | $0.57 | 101.2 |
| 12. | **Campbell's® Chunky™ Beef with Country Vegetables Soup** | 107.0 | $1.07 | 99.7 |
| 13. | **Campbell's® Condensed Lentil Soup** | 63.0 | $0.64 | 98.7 |
| 14. | **Campbell's® Condensed Vegetarian Vegetable Soup** | 53.9 | $0.55 | 98.1 |
| 15. | **Campbell's® Condensed Vegetable Soup** | 53.1 | $0.54 | 97.8 |
| 16. | Sweet potatoes, canned | 84.5 | $0.89 | 94.9 |
| 17. | **Campbell's® Condensed Vegetable Beef Soup** | 59.0 | $0.63 | 93.6 |
| 18. | **Campbell's® Chunky™ Healthy Request® Sirloin Burger w/ Country Vegetables Soup** | 97.8 | $1.05 | 92.9 |
| 19. | **Campbell's® Select Harvest® Tomato Garden Soup** | 91.3 | $1.01 | 90.2 |
| 20. | **Campbell's® Chunky™ Hearty Bean '9' Ham Soup** | 87.4 | $1.03 | 85.2 |
| 21. | **Campbell's® Select Harvest® Light Savory Chicken with Vegetables Soup** | 84.1 | $1.00 | 84.2 |
| 22. | Asparagus, fresh | 138.1 | $1.62 | 82.8 |
| 23. | **Campbell's® Select Harvest® Slow Roasted Beef and Vegetables Soup** | 87.9 | $1.07 | 82.6 |
| 24. | **Campbell's® Select Harvest® Vegetable Medley Soup** | 82.5 | $1.00 | 80.9 |
| 25. | Tomatoes, raw | 38.1 | $0.48 | 80.1 |
| 26. | **Campbell's® Select Harvest® Minestrone Soup** | 64.5 | $1.06 | 79.6 |
| 27. | **Campbell's® Select Harvest® Light Vegetable and Pasta** | 85.6 | $1.08 | 79.5 |
| 28. | **Campbell's® Condensed Tomato Soup Aperitif** | 27.7 | $0.35 | 79.4 |
| 29. | **Campbell's® Chunky™ Healthy Request® Vegetable Soup** | 83.7 | $1.06 | 79.3 |
| 30. | **Campbell's® Condensed Minestrone Soup** | 42.6 | $0.55 | 77.4 |
| 31. | Asparagus, canned | 31.5 | $0.41 | 77.0 |
| 32. | **Campbell's® Chunky™ Savory Vegetable Soup** | 79.7 | $1.04 | 76.5 |
| 33. | **Campbell's® Select Harvest® Split Pea with Roasted Ham Soup** | 78.0 | $1.13 | 69.2 |
| 34. | **Campbell's® Chunky™ Healthy Request® Old Fashioned Vegetable Beef Soup** | 71.8 | $1.04 | 69.0 |
| 35. | **Campbell's® Select Harvest® Light Italian-Style Vegetable** | 75.4 | $1.10 | 68.8 |
| 36. | lettuce, iceberg, fresh | 19.7 | $0.37 | 53.5 |
| 37. | Green beans, fresh, cooked | 33.3 | $0.65 | 51.1 |
| 38. | Summer squash, cooked | 18.7 | $0.41 | 45.2 |
| 39. | French fries, fast food | 38.8 | $1.14 | 34.0 |
| 40. | String beans, canned | 28.2 | $0.89 | 31.6 |
| 41. | Peas, fresh, cooked | 64.1 | $2.60 | 24.7 |

## Median NRF 9.3 Scores for 9 USDA Food Groups

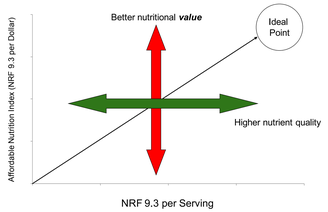
Analysis based on 1387 foods from FNDDS 1.0 (2001-2002) and plotted against energy density.




Vegetable soups in the FNDDS (2001-2002) had the same nutritional value as vegetables.

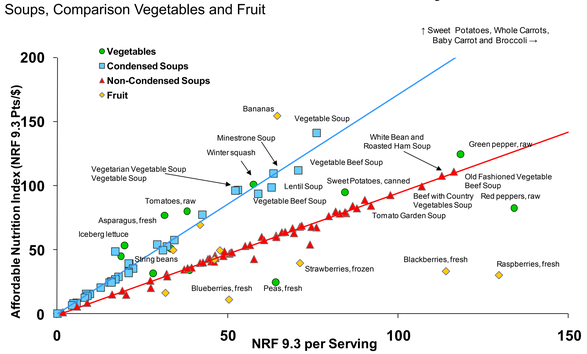
## How to Identify Affordable Nutrient Rich Foods?

The orienting plot shows how nutrient values per serving correspond to the Affordable Nutrition Index (ANI).

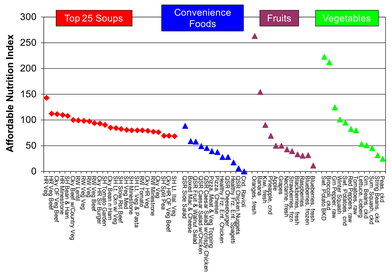



## Affordable Nutrition Index and Nutrient Density:

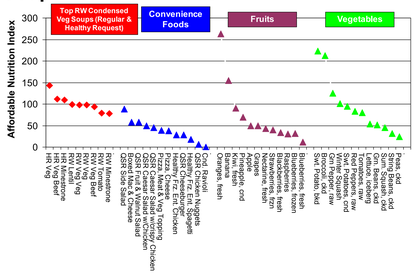
Soups, Comparison Vegetables and Fruit




## Affordable Nutrition Index: Top Scoring Soups vs. Other Foods




## Affordable Nutrition Index: Condensed Vegetable Soups vs. Other Foods




## Summary of Results

- The Nutrient Rich Foods Index NRF9.3 is a formal rating system based on nutrients to encourage and limit that ranks foods according to their nutritive value. It can be used to identify the most nutritious foods across and within food groups.
- Dividing NRF9.3 scores per serving by food price per serving yields the Affordable Nutrition Index (ANI). The new metric identifies foods that are both affordable and nutritious.
- ANI ratings for vegetables showed that carrots, sweet potatoes, and broccoli were at the top of the list. Squash, string beans, peas and lettuce were also highly ranked. Among fruits, oranges and bananas were unrivalled when it came to delivering nutrition per food dollar.
- On a per serving basis, 25 processed soups had higher ANI ratings compared to many fresh or cooked vegetables (peas, string beans, squash, lettuce, tomatoes) or to fresh fruits (blueberries, raspberries, blackberries, strawberries, grapes, nectarines, apples).
- All 25 soups had higher ANI ratings when compared to such convenience foods as canned ravioli, chicken nuggets, cheese pizza, or Caesar salad with dressing.
- On a per serving basis, all 9 condensed vegetable soups that delivered at least half a serving of vegetables had higher ANI scores than all convenience foods, and higher scores than peas, beans, squash, lettuce, raw tomatoes, apples, grapes, nectarines, and berries.

## Conclusion

- A new tool the Affordable Nutrient Index (ANI) has been developed to assess simultaneously nutrition quality and cost as an approach to help identify nutritious foods that are affordable.
- This study of nutritive value and cost of different foods shows that soups are both nutritious and affordable.
- Canned vegetable soups are a convenient option for building healthful yet affordable diets that are consistent with Dietary Guidelines. The use of soups can be helpful in reducing disparities in access to healthy fresh foods.
- Healthy choices need not be expensive if the concepts of the foods' nutrient density and value are successfully conveyed to consumers.
- More studies are needed to expand nutrient and cost related research to more food categories and with respect to gender, age and income.

## References

1. Progressive Grocer, New Index Takes Different Approach to Nutrition . Available online at: http://www.progressivegrocer.com/progressivegrocer/content_display/esearch/e3ia88ac756513e0fd952698cd260792c53. Accessed September 15, 2009.
2. Fulgoni VL, Keast DR, Drewnowski A. Development and Validation of the Nutrient-Rich Foods Index: A Tool to Measure Nutritional Quality of Foods. J Nutrition. 2009 Aug; 139(8):1549-1554.
3. USDA Food and Nutrient Database for Dietary Studies, 1.0. 2004. Beltsville, MD: Agricultural Research Service, Food Surveys Research Group.
4. United States Department of Agriculture. Center for Nutrition Policy and Promotion. Development of the CNPP Prices Database. May 2008. Available online at: http://www.cnpp.usda.gov/Publications/FoodPlans/MiscPubs/PricesDatabaseReport.pdf. Accessed
5. Campbell's Soup List Prices, 2008. Campbell's Soup Company.
6. Monsivais P, Drewnowski A. The Rising Cost of Low-Energy-Density Foods. Journal of the American Dietetic Association. 2007 December; 107(12): 2071-2076.
7. 21 CFR 101.9 (c) (9) [1993]

Supported by a grant from the Campbell Soup Company