Nutrient Rich Foods Coalition™
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Nutrient Rich Foods Index: Validation

The Nutrient Rich Foods (NRF) Index was developed to help people build healthier diets based on the concept of nutrient density. This fact sheet outlines the validation step of the objective and systematic approach used to develop the NRF index - a scientifically valid definition of nutrient density. Following extensive research, NRF scientists published a manuscript in the August 2009 issue of *Journal of Nutrition*† detailing NRF Index development and validation against the USDA's 2005 Healthy Eating Index (HEI).

The Healthy Eating Index

NRF scientists evaluated correlations between NRF diet scores and HEI scores to develop and validate the NRF formula that could best predict diet quality. The HEI is a standardized tool developed by the USDA for use in nutrition monitoring, research, and interventions. It measures compliance with the 2005 Dietary Guidelines for Americans and MyPyramid. Using a 100-point scale, the HEI awards points to diets for consumption of various food and nutrient components, with minimum and maximum scores awarded for meeting recommendations listed in the chart below.

Healthy Eating Index - 2005 Components and Standards for Scoring[1]

SOURCE: http://www.cnpp.usda.gov/HealthyEatingIndex.htm

Component	Maximum Points	Standard for Maximum Score	Standard for Minimum Score of Zero
Total Fruit (includes 100% juice)	5	≥0.8 cup equiv. per 1,000 kcal	No Fruit
Whole Fruit (not juice)	5	≥0.4 cup equiv. per 1,000 kcal	No Whole Fruit
Total Vegetables	5	≥1.1 cup equiv. per 1,000 kcal	No vegetables
Dark Green and Orange Vegetables and Legumes[2]	5	≥0.4 cup equiv. per 1,000 kcal	No Dark Green or Orange Vegetables and Legumes
Total Grains	5	≥3.0 oz equiv. per 1,000 kcal	No Grains
Whole Grains	5	≥1.5 oz equiv. per 1,000 kcal	No Whole Grains
Milk[3]	10	≥1.3 cup equiv. per 1,000 kcal	No Milk
Meat and Beans	10	≥2.5 oz equiv. per 1,000 kcal	No Meat or Beans
Oils	10	≥12 grams per 1,000 kcal	No Oil
Saturated Fat[4]	10	≤7% of energy[5]	≥15% of energy
Sodium	10	≤0.7 gram per 1,000 kcal	≥2.0 g per 1,000 kcal
Calories from Solid Fat, Alcohol, and Added Sugar (SoFAAS)	20	≤20% of energy	≥50% of energy

1 Intakes between the minimum and maximum levels are scored proportionately, except for Saturated Fat and Sodium (see note 5).
2 Legumes counted as vegetables only after Meat and Beans standard is met.
3 Includes all milk products, such as fluid milk, yogurt, and cheese, and soy beverages.
4 Includes nonhydrogenated vegetable oils and oils in fish, nuts, and seeds.
5 Saturated Fat and Sodium get a score of 8 for the intake levels that reflect the 2005 Dietary Guidelines, <10% of calories from saturated fat and 1.1 grams of sodium/1,000 kcal, respectively.

† Fulgoni VL 3rd, Keast DR, Drewnowski A. Development and Validation of the Nutrient-Rich Foods Index: A Tool to Measure Nutritional Quality of Foods. *Journal of Nutrition.* August 2009.

NRF Index Development

The process for developing the NRF Index included calculating diet scores for each participant in the NHANES 1999-2000 and 2001-2002 using HEI, and for a family of NRF Indices that varied in their components and how they were calculated, including:

1) Nutrients (number and specific nutrients included)
2) Serving basis (reference amounts customarily consumed (RACC) or 100 kcals)
3) Calculation basis (sum, mean, or ratio) of percent Daily Value (DV)

Throughout the development process, correlation with HEI was used to guide decisions about index components. Once the serving and calculation bases were determined (100 kcals and sum, respectively), a family of NRF Indices with a range of nutrients to encourage (6-15) and three nutrients to limit (saturated fat, added sugar and sodium) were validated against HEI diet scores from NHANES 1999-2002. The best performing index was NRF 9.3, which contains nine nutrients to encourage (protein, fiber, vitamins A, C, E, calcium, magnesium, iron, potassium) and three nutrients to limit.

Steps in Validation Process

Step 1: Score each individual's diet in NHANES to determine their HEI score

Step 2: Score each individual's diet in NHANES to determine their NRF diet score (calorie weighted average)

Step 3: Conduct a linear regression analysis using NRF score as the predictor of HEI to determine the correlation between HEI and NRF scores. For HEI and NRF, the correlation is highly significant and positive (as NRF scores increase, HEI scores increase)

Step 4: Determine the R-squared value (which measures the percent variation explained in HEI by NRF); determine NRF Index components to maximize R-squared value

Linear Regression and HEI

An R-squared value of one means that the correlation between two variables is perfect, and knowing the value of one variable, you could predict the value of the other variable. For the two variables HEI and NRF, the R-squared value is less than one, which indicates NRF is not a perfect predictor of HEI. However, for dietary intake, which has many influencers, this is not surprising. NRF 9.3 can explain about 45% of the variance in HEI scores, a level that is readily acceptable in the food and nutrition field.