Review Article

Putting the pyramid into action: the Healthy Eating Index and Food Quality Score

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Consumption patterns are changing globally. As a result both researchers and policy makers require simple, easy to use measures of diet quality. The Healthy Eating Index (HEI) was developed as a single, summary measure of diet quality. The original HEI was a ten component index based on the US Dietary Guidelines and the Food Guide Pyramid. Research on the HEI indicates that the index correlates significantly with the RDA's for a range of nutrients and with an individual's self-rating of their diet. The revised HEI provides a more disaggregated version of the original index based on the 2005 Dietary Guidelines for Americans. Within each of the five major food groups, some foods are more nutrient dense than others. Nutrient Density algorithms have been developed to rate foods within food groups. The selection of the most nutrient dense foods within food groups lead to a dietary pattern with a higher HEI. The implications of using the HEI and nutrient density to develop interventions are discussed in this presentation.

Key Words: Diet Quality, Nutrient Density, HEI

INTRODUCTION

More and more countries worldwide have developed or are developing national food based dietary guidelines. A recent report indicates that there is remarkable similarities in the food based guidelines that have emerged, most noticeably the emphasis on whole grains, fruits and vegetables.[1] In addition to the emergence of dietary guidelines, there has also been a call in the research and policy communities to develop simple indicators to measure diet quality. This paper discusses the development and use of the Healthy Eating Index, a single, summary measure of diet quality. In addition, a food quality score used to rate the nutrient density of individual foods is presented.

Healthy Eating Index

The Healthy Eating Index (HEI) was developed in the mid-1990's to provide a single, summary measure of overall dietary quality.[2] The HEI was intended to provide a way to evaluate diet quality at a given point in time, as well as method for monitoring changes in the food patterns over time.

The HEI is a ten component index (see Fig. 1). The first five components of the index are based on the five major food groups of the 1992 USDA Food Guide Pyramid – grains, fruits, vegetables, meat and alternates and milk.[3] Components six to ten are based are aspects of the 1995 Dietary Guidelines for Americans[4] including total fat, saturated fat, cholesterol, sodium and variety. Each of the ten components ranges in score from zero to ten.

The criteria for scoring each of these ten components is provided in figure 2. Thus the composite HEI score can potentially range from a minimum of zero to a maximum score to 100.

Figure 3 provides an illustration of the distribution of the HEI scores for a representative sample of the U.S. population in 1999-2000.[5] The major portion of the sample has an average HEI in the range of 51 to 80 and category that is defined as "needs improvement". Only 10% of the population has an HEI that is characterized as "good" with a HEI above 80; similarly 16% of the population has an HEI described as "poor", falling in the range of 50 or less.

The mean scores for each of the ten components are shown in figure 4.[5] By far, the lowest score – 3.8 – is found for the fruits group. Scores for other HEI components range from 5.9 to 7.7. The average total HEI tends to fall in the range of 62 to 64 and there is little variation in the population over time in the HEI.[6] This last statistic appears to indicate that on a population level it is difficult to improve the HEI in a short period of time.

Data from a representative sample for the period 1994-1996, were used to validate the HEI. The HEI correlated positively, significantly with a range of nutrient intakes.[2] In addition, the HEI was linked to an individual's self perception of their diet. Thus a person who self rated their diet as poor or fair, were more likely to have a low HEI than were individuals who rated their diets as good to excellent.[2]

Finally, a person's HEI correlated with an individual's Body Mass Index (BMI) computed from self reported

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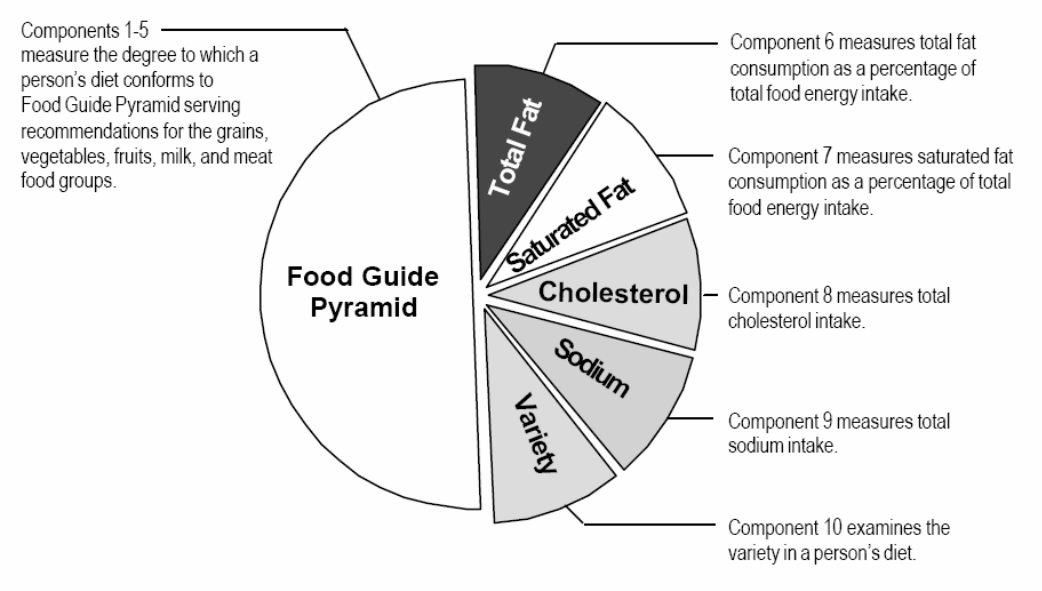

Figure 1. Components of the HEI

	Score range[1]	Criteria for maximum score of 10	Criteria for minimum score of 0
Grain consumption	0 to 10	6-11 servings[2]	0 servings
Vegetable consumption	0 to 10	3-5 servings[2]	0 servings
Fruit consumption	0 to 10	2-4 servings[2]	0 servings
Milk consumption	0 to 10	2-3 servings[2]	0 servings
Meat consumption	0 to 10	2-3 servings[2]	0 servings
Total fat intake	0 to 10	30% or less energy from fat	45% or more energy from fat
Saturated fat intake	0 to 10	Less than 10% energy from saturated fat	15% or more energy from saturated fat
Cholesterol intake	0 to 10	300 mg or less	450 mg or more
Sodium intake	0 to 10	2400 mg or less	4800 mg or more
Variety	0 to 10	8 or more different items in a day	3 or fewer different items in a day

[1]People with consumption or intakes between the maximum and minimum ranges or amounts were assigned scores proportionately.
[2]Number of servings depends on Recommended Energy Allowance-see table 2. All amounts are on a per-day basis.

Figure 2. HEI Component Mean Scores

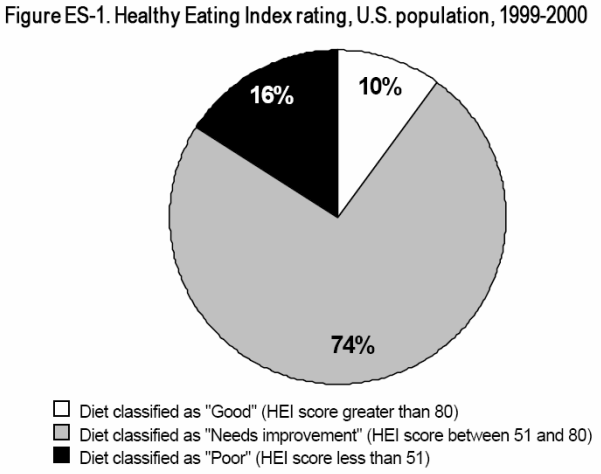

Figure 3. Overall HEI Score

height and weight.[2]

It was always the intention that the HEI would be updated as newer science became available. Thus after the release of the 2005 Dietary Guidelines for Americans[7], the HEI was revised. Figure five presents the updated components of the HEI included the scoring system used.[8] The major changes in the 2005 HEI include: an emphasis on 50% of the fruit category coming from whole fruit; an separate emphasis on orange and dark green vegetables as well as legumes; a specification that 50% of the items from the grains category should be whole grains; a separate category for discretionary calories from solid fats, alcohol and added sugars.

Nutrient Density Revisited

The 2005 Dietary Guidelines for Americans[7] refer to the concept of nutrient density throughout the report. While the concept of nutrient density is not new, these latest Dietary Guidelines put a renewed emphasis to a scientific approach that was developed more than 30 years ago.[8] Statements such as[7]:

"Get the most nutrients out of your calories"

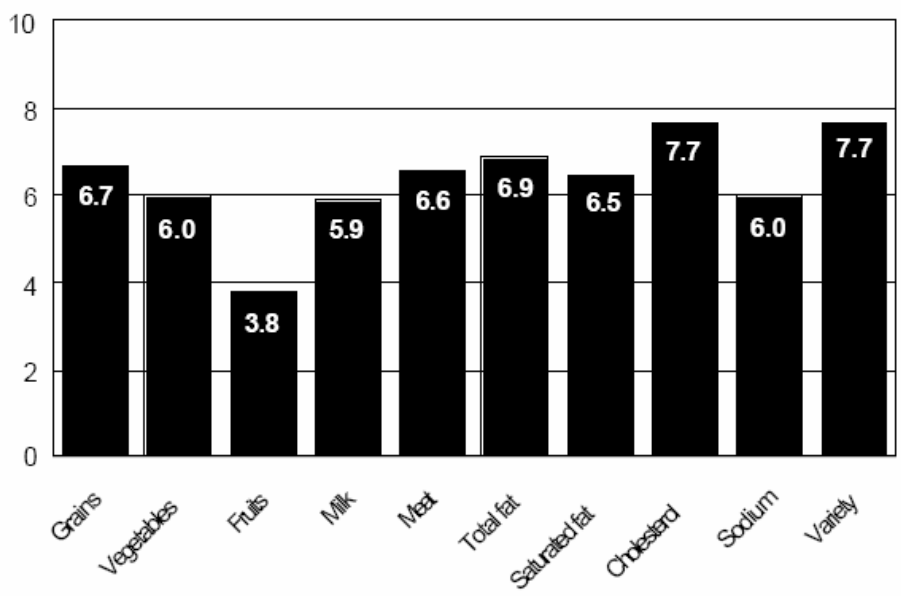

Figure 4. Mean for 1999-2000 – 63.8

Healthy Eating Index–2005 components and standards for scoring[1]

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 or 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[4]	10	≥12 grams per 1,000 kcal	No Oil
Saturated Fat	10	≤7% of energy[5]	≥15% of energy
Sodium	10	≤0.7 gram per 1,000 kcal[5]	≥2.0 grams 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.
[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.

Figure 5. HEI 2005

And

"Make smart food choices for every food group"

Reinforce the concept of nutrient density.

However, nutrient density is not an idea that is easily understood by the consumer. In order to provide a method that would allow consumers to rate the nutritional quality of individual foods, a food quality score (FQS) was devised.[9] Similar to the development of the HEI, the food quality score was based on guidance provided by the 2005 Dietary Guidelines. The Food Quality Score .[9] is based on two groups of nutrients. First a category called shortfall nutrients was identified in the 2005 Dietary Guidelines. Shortfall nutrients are those consumed in in-sufficient quantities in the U.S. population and include

Table 1. Dairy

	Food Quality Score		
Description	FQS_1 Universal	FQS_2 Separate	FQS_3 Expanded
Milk, dry, whole 3.25% milk fat	0.96	1.60	0.94
Milk, nonfat, fluid, with added vitamin A (fat free or skim)	4.30	7.62	4.30
Ice creams, vanilla	0.39	0.61	0.38

Table 2. Grains

	Food Quality Score		
Description	FQS_1 Universal	FQS_2 Separate	FQS_3 Expanded
Bread, white, commercially prepared	0.98	1.11	1.34
Cake, angel food, commercially	0.62	0.59	0.71
Cereals ready-to-eat, GENERAL MILIS, TOTAL Corn Flakes	6.02	5.48	5.95

Table 3. Fruits

	Food Quality Score		
Description	FQS_1 Universal	FQS_2 Separate	FQS_3 Expanded
Apples, raw, with skin	4.18	5.46	3.19
Oranges, raw, all commercial varieties	22.4	30.2	13.3

Table 4. Food Quality Score Averages

Food Group	FQS Score average
Fruits	8.09
Vegetables	8.02
Grains	1.89
Dairy	1.24
Meats	1.03
Other	1.21

fiber, Vitamins A, B12, E, C, D, folate, calcium, magnesium, iron and potassium. The second category is called avoidance nutrients and as the name implies are ones which, on average, need to be reduced in the American diet. Avoidance nutrients include calories, saturated fats, cholesterol, sodium and Trans fats.

A series of Food Quality Scores (FQS) were developed. The Universal FQS (FQS1) applies one algorithm to all foods using the ratio of shortfall nutrients to avoidance nutrients. A second FQS was developed using algorithms that were specialized to specific food group. The 2005 Dietary Guidelines were clear that foods from each of the food groups were needed since each group provided foods that were good and excellent sources of different nutrients. Finally an algorithm with an expanded group of 23 nutrients was developed.

Data from the USDA SR18 nutrient data base were used to compute and compare the three different FQS. Some points are worth noting. Nutrients added through fortification were treated identically to nutrients naturally occurring in foods. Mixed dishes composed of items from more than one food group were decomposed into their component food groups. For example, lasagna was assigned proportionate parts to the grains, milk, meat and vegetable groups for analysis of the food group specific FQS.

Tables 1 through 3 illustrate the FQS using the three alternative approaches. While the absolute FQS varies with the method, the ranking of items within food groups does not vary. Thus for example, on all three scores dry, ice cream has the lowest ranking on the items in the dairy group.

Table 4 illustrates the average universal FQS for the five food groups. The FQS for fruits and vegetables, not surprisingly, is substantially higher than for the other three food groups.

CONCLUSIONS AND RECOMMENDATIONS

The Healthy Eating Index has been used effectively for monitoring, evaluation and has been adapted to a more consumer friendly version.[10] Putting the concept of nutrient density into practice is more of challenge. Further research needs to be conducted to ascertain the effect of Food Quality Scores, or indeed any food rating system, on consumer food choices. Researchers have long known that the major determinants of food choice are taste, price, and convenience.[11] Whether promotion of a specific food rating system will significantly influence food choices and food consumption needs to be empirically determined. A Food Quality System based on nutrient density can be one tool that can facilitate more healthful food purchases and dietary patterns.

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AUTHOR DISCLOSURES

Eileen Kennedy, no conflicts of interest.

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