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A revised version of the Healthy Eating Index for the Brazilian population

ABSTRACT

The revised version of the Brazilian Healthy Eating Index is an indicator of dietary quality developed according to current nutritional recommendations. Dietary data were obtained from a population-based survey, the 2003 *Inquérito de Saúde e Alimentação* (ISA – Health and Diet Survey)-Capital. The Revised Index consists of 12 components: nine food groups included in the 2006 Brazilian Dietary Guidelines, in which daily portions are expressed in terms of energy density; two nutrients (sodium and saturated fats), and SoFAAS (calories from solid fat, alcohol and added sugar). The Revised Brazilian Healthy Eating Index allows for the measurement of dietary risk factors for chronic diseases, evaluating and monitoring the diet at both individual and population levels.

DESCRIPTORS: Diet, classification. Diet Surveys, methods. Nutrition Assessment. Nutritional Surveillance.

INTRODUCTION

The complexity of the human diet has led to the appearance of numerous different methods to evaluate food consumption and incorporate correlations between foods and nutrients into the analysis of a population's diet. In Brazil, Fisberg al[2] adapted and validated the Healthy Eating Index (HEI)[a] for the Brazilian population, generating the Brazilian Healthy Eating Index (BHEI) [*Índice de Qualidade da dieta (IQD)*]. This index evaluates a combination of different types of foods, nutrients and other components of the diet with regard to daily intake recommendations and/or health outcomes. The publication of the Dietary Guidelines for the Brazilian Population [*Guia Alimentar para a População Brasileira*] in 2006 (from here on referred to as the 2006 Dietary Guidelines),[b] raised the need for a reviewed version of BHEI. Thus, the aim of the present study was to develop the Brazilian Healthy Eating Index – Revised (BHEI-R) and to describe this development process.

METHODS

In order to identify dietary patterns, we used dietary data from the Heath and Diet Survey Capital-2003 [*Inquérito Saúde e Alimentaçao (ISA)-Capital-2003*].

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[a] Guenther PM, Reedy J, Krebs-Smith SM, Reeve BB, Basiotis PP. Development and evaluation of the Healthy Eating Index-2005: technical report. Alexandria: Center for Nutrition Policy and Promotion, U.S. Department of Agriculture; 2007[cited 2010 Apr 25]. Available from: http://www.cnpp.usda.gov/HealthyEatingIndex.htm
[b] Ministério da Saúde. Secretaria de Atenção à Saúde. Coordenação-Geral da Política de Alimentação e Nutrição. Guia alimentar para a população brasileira: promovendo a alimentação saudável. Brasília; 2006. (Série A. Normas e Manuais Técnicos).

This was a cross-sectional, population-based survey of a representative sample of 2,298 adolescents (12 years or older), adults, and elderly subjects of both sexes living in the municipality of Sao Paulo, Brazil. Food consumption was measured by a 24-hour dietary recall (R24h), administered by previously trained interviewers. Household measurements were transformed into measurement units and nutritional value was calculated using the Nutrition Data System for Research software (NDS-R, 2007 version). Greater details on the survey can be obtained elsewhere.[1] While developing BHEI-R, we took into account the distribution curves for the intake of saturated, trans, monounsaturated, polyunsaturated, and fish fats; sodium; alcohol, and added sugar obtained from the survey.

BHEI-R programming was developed in STATA software (10.0) and it is available by contacting the authors.

Components based on food intake

The elaboration of BHEI-R and the definition of cutoff points for the maximum, intermediate, and minimum scores for each component was based on recommendations from the 2006 Dietary Guidelines,[b] as well as from the World Health Organization (WHO),[5] the Institute of Medicine[3], the Healthy Eating Index 2005 (HEI-2005),[a] and the Brazilian Cardiology Society.[4]

We defined the recommended daily number of portions of each group of foods for every 1,000 kcal, as an attempt to maintain correspondence with the 2006 Dietary Guidelines.[b]

For each food group, ingestion equal to or greater than the recommended per 1,000 kcal was given the maximum score (five or 10 points). No intake of foods in that group was given a zero score, and intermediary values were given a score proportional to the amount consumed (Table).

Since recommendations regarding the intake of components "Whole Fruit," "Dark Green and Orange Vegetables and Legumes," and "Whole Grains" were absent from the 2006 Dietary Guidelines,[b] the number of portions of these foods was calculated proportionally to the components "Total Fruit," "Total Vegetables," and "Grains, Roots, and Tubers," respectively.

The 2006 Dietary Guidelines[b] recommend the intake of three portions of "Grains, Roots, and Tubers" per 1,000 calories. In BHEI-R, this was distributed among the components "Grains, Roots, and Tubers" (2.0 portions) and "Whole Grains" (1.0 portion). The group "Grains, Roots and Tubers" refers not only to the intake of grains, but also to other foods rich in carbohydrates, such as biscuits, pasta, potatoes and others, which are the energetic basis of the Brazilian diet.[b]

Legumes play a relevant role in the Brazilian diet, and are an important source of protein, fiber, and minerals. Thus, BHEI-R followed the methodology proposed in HEI-2005[a]: the score for the component "Meat and Beans" was estimated initially as the sum of the energetic value of the "Meat and Eggs" group, to which the caloric value of "Legumes" was added until the maximum score for the "Meat and Beans" component was met (190 kcal = 1 portion = 10 points). Any excess energy from legumes is added simultaneously to the "Dark Green and Orange Vegetables" and "Total Vegetables" groups.

Components based on nutrient intake

In order to include the component "Sodium" in BHEI-R in the form of energy density, we used an approach similar to that used to define the Dietary Reference Intakes, which vary according to age and are calculated based on the median energy intake of each age group.[3] For the youth and adult population, the adequate intake[3] of sodium is 1.5 g, and median energy intake is 2,150 kcal, that is, 0.7 g of sodium per 1,000 kcal. We chose to calculate cutoff points for sodium based on a 2,000 kcal energy intake, according to the 2006 Dietary Guidelines,[b] which is close to the median energy intake of the population of the state of São Paulo (1,907 kcal). Thus, the highest possible score is assigned to diets that have less than 1,5 g/2,000 kcal, or 0.75 g/1,000 kcal. Intermediate scores were based on the maximum value stipulated by the 2006 Dietary Guidelines[b] (2.0 g/2,000 kcal), or 1.0g/1,000 kcal (percentile 5 of the distribution). The minimum score was defined as twice that recommended by the 2006 Dietary Guidelines,[b] or 2.0g/1,000 kcal (percentile 82).

The definition of the minimum score of "Saturated Fat" was based on the same methods used in HEI-2005. The lower cutoff point was set at about 85th percentile of the intake distribution of the ISA-Capital-2003 survey, or 15% of the total energy intake of the diet. The maximum score (7% of the energy intake) was based on to the guidelines for dyslipidemia and prevention of atherosclerosis of the Brazilian Cardiology Society,[4] which limits the intake of saturated fat to 7% of the energy intake. The percentiles corresponding to the minimum and maximum scores are the same as those of the HEI-2005 population, indicating a certain similarity in the intake of saturated fats between the United States and Brazilian populations.[b] The intermediate cutoff point – 10% of the energy intake – was based on the WHO recommendation.[5]

Components based on the intake of nutrients and dietary items

The maximum score for the component "Oil, Oleaginous foods, and Fish Oils" is based on the "Oils, Fats, and Oleaginous Seeds" item from the 2006 Dietary Guidelines, or 0.5 portion/1,000 kcal.[b]

Table. Distribution of scores and portions for the different components of the Healthy Eating Index 2005 and of the original and revised versions of the Brazilian Healthy Eating Index. Sao Paulo, Southeastern Brazil, 2010.

Component	Score (points)				
	0	5	8	10	20
BHEI					
Total fruit	0 ⟵——————⟶ 3 to 5 portions				
Vegetables	0 ⟵——————⟶ 4 to 5 portions				
Total grains[a]	0 ⟵——————⟶ 5 to 9 portions				
Milk and dairy	0 ⟵——————⟶ 3 portions				
Meat and eggs	0 ⟵——————⟶ 1 to 2 portions				
Legumes	0 ⟵——————⟶ 1 portion				
Total fats	≥ 45 ⟵——————⟶ ≤ 30% of VET				
Sodium	≥4,8 ⟵——————⟶ ≤ 2.4 g				
Cholesterol	≥0,45 ⟵——————⟶ ≤ 0.3 g				
Variety of the diet	≤ 3,0 ⟵——————⟶ ≥ 8.0 types of foods				
HEI-2005					
Total fruit[b]	0 ⟷ ≥ 0.8 cup eq/1.000 kcal				
Whole fruit[c]	0 ⟷ ≥ 0.4 cup eq/1.000 kcal				
Total vegetables	0 ⟷ ≥ 1.1 cup eq/1.000 kcal				
Dark green and orange vegetables and legumes	0 ⟷ ≥ 0.4 cup eq/1.000 kcal				
Total grain	0 ⟷ ≥ 3.0 unit eq/1.000 kcal				
Whole grains	0 ⟷ ≥ 1.5 unit eq/1.000 kcal				
Milk	0 ⟵——————⟶ ≥ 1.3 cup eq/1.000 kcal				
Meat and beans	0 ⟵——————⟶ ≥ 2.5 unit eq/1.000 kcal				
Oils	0 ⟵——————⟶ ≥ 12 g/1.000 kcal				
Saturated fat	≥15 ⟵——————⟶		10 ⟷7% of VET		
Sodium	≥2,0 ⟵——————⟶		1,1 ⟷ ≤ 0.7 g/1.000 kcal		
SoFAAS	≥50 ⟵———————————————⟶				≤ 20% of VET
BHEI_Revised					
Total fruit[b]	0 ⟷ 1.0 portion/1.000 kcal				
Whole fruit[c]	0 ⟷ 0.5 portion/1.000 kcal				
Total vegetables[d]	0 ⟷ 1.0 portion/1.000 kcal				
Dark green and orange vegetables and legumes[d]	0 ⟷ 0.5 portion/1.000 kcal				
Total grains[a]	0 ⟷ 2.0 portions/1.000 kcal				
Whole grains	0 ⟷ 1.0 portion/1.000 kcal				
Milk and dairy[e]	0 ⟵——————⟶ 1.5 portion/1.000 kcal				
Meat, eggs, and legumes	0 ⟵——————⟶ 1.0 portion/1.000 kcal				
Oils[f]	0 ⟵——————⟶ 0.5 portion/1.000 kcal				
Saturated fat	≥ 15 ⟵——————⟶		10 ⟷7% of VET		
Sodium	≥ 2,0 ⟵——————⟶		1,0 ⟷ ≤ 0.7 g/1.000 kcal		
SoFAAS	≥ 35 ⟵———————————————⟶				≤ 10% of VET

[a] Total grains = includes grains, roots, and tubers
[b] Includes fruit and natural fruit juices
[c] Excludes fruit juices
[d] Legumes counted as vegetables only after Meat and Beans standard is met
[e] Includes milk and dairy products and soy milk
[f] Includes mono and polyunsaturated fats, oils from oleaginous vegetables and fish oils
BHEI: Brazilian Healthy Eating Index
HEI: Healthy Eating Index; SoFAAS: Calories from solid fats, alcoholic beverages, and added sugars; TEV: Total energy value; Eq: equivalents

In Brazil, there are no recommendations regarding the intake of the SoFAAS component (calories from solid, saturated, and trans fats, alcohol, and added sugar). Therefore, the minimum and maximum scores were set to, respectively, 35% and 10% of the energy intake from SoFAAS. These cutoff points were based on percentiles 16 and 85, respectively, of the distribution of SoFAAS intake among the population of the ISA-Capital-2003 survey, following the methodology used in HEI-2005.[a]

RESULTS E DISCUSSION

BHEI-R comprises 12 components, nine of which are food groups, two of which are nutrients, and the last of which represents the sum of the energy value contributed by solid fats, alcohol, and added sugar (the SoFAAS component) (Table).

BHEI-R can be applied to both individuals and populations. However, when used on individuals, BHEI-R requires an estimate of usual intake, which requires several days of food intake data, therefore minimizing intrapersonal variation. In this case, the component scores can be calculated by dividing total food-group or nutrient intake over several days by the total calories consumed in the same period.[b]

One of the strengths of the present study is the use of the recommendations proposed in the 2006 Dietary Guidelines, aimed at promoting health through the prevention of nutritional deficiencies and non-communicable chronic diseases such as diabetes, hypertension, and obesity, among the Brazilian Population.[b] This instrument can therefore be administered to individuals during different stages of life (with the exception of children younger than the age of two years), and may prove useful for monitoring health-promoting initiatives and nutritional education activities, planning and evaluation of nutritional and dietary interventions, epidemiological surveys, and economics research.[b]

The major strength of the BHEI-R is that it assesses diets on a per 1,000 calorie basis, so as to characterize the quality of the diet independent of individual energy needs, which are difficult to measure precisely. However, BHEI-R, as HEI-2005, does not measure energy intake, and is concerned with the quality of the diet rather than with the amount of food ingested. By associating quality of diet with epidemiological outcomes related to energy intake, one should consider, in addition to BHEI-R,[a] indicators of energy balance (e.g., body mass index) or adjustment for energy according to methods proposed in the literature.

Although the social and economic structure in Brazil differs from that of the United States, both show a trend towards globalization, indicating similarities in terms of dietary patterns. The rapid urbanization and industrialization of certain cities and metropolitan areas have made Brazil comparable, to a certain extent, to developed countries.

A limitation of BHEI-R and HEI-2005 is that both indexes rely on dietary data for a single 24-hour period obtained in population-based cross-sectional studies. Therefore, usual intake cannot be estimated. However mean usual intake among a population of individuals can be obtained if individual questionnaires are obtained for all days of the week and across all four seasons of the year,[a] as was the case for ISA Capital-2003.

BHEI-R is capable of simultaneously evaluating several components of the diet, providing an estimate of its quality regardless of the amount of food consumed. Moreover, the use of the 2006 Dietary Guidelines to update BHEI led to an instrument that is useful for monitoring and evaluating the adherence of the Brazilian population to current nutritional recommendations for the different stages of life. Regardless of these advantages, future studies should be conducted to evaluate the applicability of this index to the Brazilian population.

REFERENCES

1. Castro MA, Barros RR, Bueno MB, César CLG, Fisberg RM. Trans fatty acid intake among the population of the city of São Paulo, Southeasthern Brazil. *Rev Saude Publica.* 2009;43(6):991-7. DOI:10.1590/S0034-89102009005000084

2. Fisberg RM, Slater B, Barros RR, Lima FD, Cesar CLG, Carandina L, et al. Healthy Eating Index: Evaluation of adapted version and its applicability. *Rev Nutr.* 2004;17(3):301-18. DOI:10.1590/S1415-52732004000300003.

3. National Academy of Sciences. Institute of Medicine. Food and Nutrition Board Dietary Reference Intakes for Water, Potassium, Sodium, Chloride, and Sulfate. Washington (DC); 2004.

4. Sociedade Brasileira de Cardiologia. IV Diretriz Brasileira sobre dislipidemias e prevenção da aterosclerose. *Arq Bras Cardiol.* 2007;88(Supll 1):2-19. DOI: 10.1590/S0066-782X2007000700002

5. World Health Organization. Global strategy on diet, physical activity and health. Geneva; 2004. (World Health Assembly 57, 17).