DOI: 10.1590/1413-81232017228.23502015

Methodological aspects of dietary quality assessment in Brazil: systematic review

Dayane de Castro Morais [1]
Luís Fernando de Sousa Moraes [1]
Danielle Cristina Guimarães da Silva [1]
Carina Aparecida Pinto [1]
Juliana Farias de Novaes [1]

Abstract *This systematic review analyzes the methodologies of Brazilian studies that have used indices to evaluate dietary quality. A systematic search was performed of electronic databases (Lilacs, Medline, SciELO and Scopus) with no restriction on the year of publication of the studies. Original, Brazilian articles were selected that assessed dietary quality using the Healthy Eating Index (HEI) or its revised versions. The descriptors were as follows: dietary quality; healthy eating index; and dietary quality index. Atotal of 45 articles were selected, of which 60% analyzed dietary quality using an instrument called the Healthy Eating Index and the rest used an index of dietary quality. Of the analyzed studies, 68.9% classified dietary quality. Most of the studies used ten items to evaluate dietary quality and were not standardized regarding methodologies. A total of 33.3% of the studies related the index to socioeconomic and demographic factors, food items and health conditions. Differences in terms of nomenclature and methodologies made it difficult to compare these studies of dietary quality.*

Key words *Dietary quality, Healthy eating index, Dietary quality index*

[1] Departamento de Nutrição e Saúde, Universidade Federal de Viçosa. Av. P.H. Rolfs s/n, Campus Universitário. 36570-900 Viçosa MG Brasil. dayanecm@yahoo.com.br

Introduction

During the last decades, there has been a worldwide change in dietary patterns, which has been characterized by an increase in the consumption of foods with high energy density and a reduction in the intake of fruit and vegetables[1]. Consequently, new methods involving a system of scoring have been developed to evaluate dietary quality and to make inferences about the relationship between diet and nutritional status[2].

In 1995, the United States Department of Agriculture (USDA) developed the Healthy Eating Index (HEI) to verify dietary adequacy according to the North American Food Guide[3]. The HEI was initially composed of ten items, five of which belong to the Food Guide Pyramid (fruits, vegetables, grains, milk and meat); four nutrients (total fats, saturated fat, cholesterol and sodium) to be consumed moderately; and the tenth item (variety), which referred to the diversity and composition of diet. Each component has a score from 0-10, totaling 100 points. A diet with a score over 80 is classified as "good"; from 51-80 "requires improvement"; and less than 51 is classified as "bad"[4,5].

The HEI was subsequently updated twice, aiming to adapt to the changes related to the Food Guide. In 2005, the HEI was reformulated (HEI-2005), based on the My Pyramid food guide, and was composed of the following 12 items: total fruits; whole fruits (juices are not counted); total vegetables; dark green and orange vegetables and legumes; total grains; whole grains; milk and dairy products; meat, eggs and legumes; total fat; saturated fat; sodium: and calories from solid fat, alcohol and added sugar. The separate food items are scored from 0-5 (the first six items), the grouped items and the nutrients are scored from 0-10 (items seven to eleven), and the last item is scored from 0-20[3].

In 2010, HEI-2005 was updated (HEI-2010) to include marine foods (fish and crustaceans) and the control of the consumption of refined grains, following recommendations by the North American Food Guide[6]. HEI-2010 maintains the principles of suitability for food groups and moderation in relation to the HEI-2005 nutrient groups. Of the 12 components, six have a maximum score of five points (total fruits; whole fruits; total vegetables; greens and legumes; high protein foods; and seafood/vegetable protein). The components of total grains; milk and derivatives, fatty acids, refined grains and sodium are scored up to ten points. Empty calories from solid fats, alcohol and added sugar are scored up to 20 points[7].

Due to differences in dietary habits in different regions it is recommended that instruments that evaluate dietary quality are adapted to a study group in order to reflect the reality of a specific location[4,8-10]. Consequently, the HEI was transposed to the Brazilian population in 2004, where it was called the Dietary Quality Index(IDQ)[11] . It was updated by Previdelli et al.[12] according to the Proposed Food Guide for the Brazilian Population and was named the Revised Dietary Quality Index (IQD-R). However, other Brazilian authors[13-15] have preferred to refer to the HEI as the Adapted Healthy Eating Index.

Consequently, this systematic review analyzes the methodologies of Brazilian studies that use indices to evaluate dietary quality.

Methodology

A systematic search was performed using electronic databases (Lilacs, Medline, SciELO, Scopus) with no restriction on the year of publication of the articles. The research terms that were used were dietary quality; healthy eating index; and dietary quality index (and their equivalents in Portuguese). These terms were chosen because in Brazil some authors use the index of dietary quality synonymously with the index of healthy eating.

Original, Brazilian articles were included in this review if they assessed dietary quality using the Healthy Eating Index, as proposed in the USA by Kennedy et al.[4] or its revised versions[3,7,9,10]. Review articles, dissertations, and theses were not included. There were no limits imposed on the language of the publication, or the date or gender of the study unit.

After researching the descriptors in the databases, the studies were reviewed and selected, evaluating the titles and abstracts first and then the articles in their entirety. In order to identify studies that were potentially relevant that were not identified in the electronic search and not yet included in the systematic review, a reverse search in the references of the selected studies was performed.

Initially, 301 studies were identified; however, 256 of these were excluded because they were performed outside Brazil, repeated, or because they did not evaluate dietary quality using the instruments of interest. After the selection stages, 45 articles were included in this review because they met the inclusion criteria (Figure 1).

The articles were read in pairs in all the selection stages, in accordance with the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analysis) recommendations to ensure that the review protocol and the inclusion and exclusion criteria were adhered to[16].

Results

The selected articles (n = 45) were published in the period 2004-2015. Of these, 60% (n = 27) analyzed dietary quality using the healthy eating index (HEI) and the rest used the dietary quality index (IQD). Of the articles that used the HEI, 16 mentioned an adaptation in the index. Of those that used the IQD, ten used an adapted index, seven used a revised index, and one used an index adjusted for energy. It should be noted that 24 authors of the selected articles reported that the instrument they used was based on the HEI, while the others reported using or adapting the index based on another instrument used to assess dietary quality in Brazilwhich was based on the HEI (Chart 1). Chart 1 describes the Brazilian studies that evaluated dietary quality and the respective methodologies that were used.

Regarding dietary classification, 31 of the studies classified dietary quality, and the majority (67.7%) used the classification proposed by Bowman et al.[5].

Of the evaluated studies, 28 of them used ten items to evaluate dietary quality, as proposed by Kennedy et al.[4] in the original HEI. It is noteworthy that in the study by Loureiro et al.[17], eleven items were evaluated, and the item of cereal was excluded because of the dietary inquiry that was used. The other studies (n = 16) used 12 items, as suggested in the revised versions of the index.

When analyzing the study outcomes and index scores, two studies did not include them[18,19] and 15 studies did not analyze them[11-14,20-30]. Study outcomes and index scores were found in 28 studies: seven of these evaluated the relationship of the index with socioeconomic and demographic factors and food items[17,31-36]; eight studies evaluated the relationship with socioeconomic factors and health[37-44]; five studies evaluated the relationship with health outcomes[45-49]; four studies evaluated the relationship with nutrients[50-53]; two studies evaluated the relationship with some type of intervention[15,54]; one study evaluated the relationship with nutrients and food items[55]; and one study evaluated the relationship with socioeconomic and demographic factors[56].

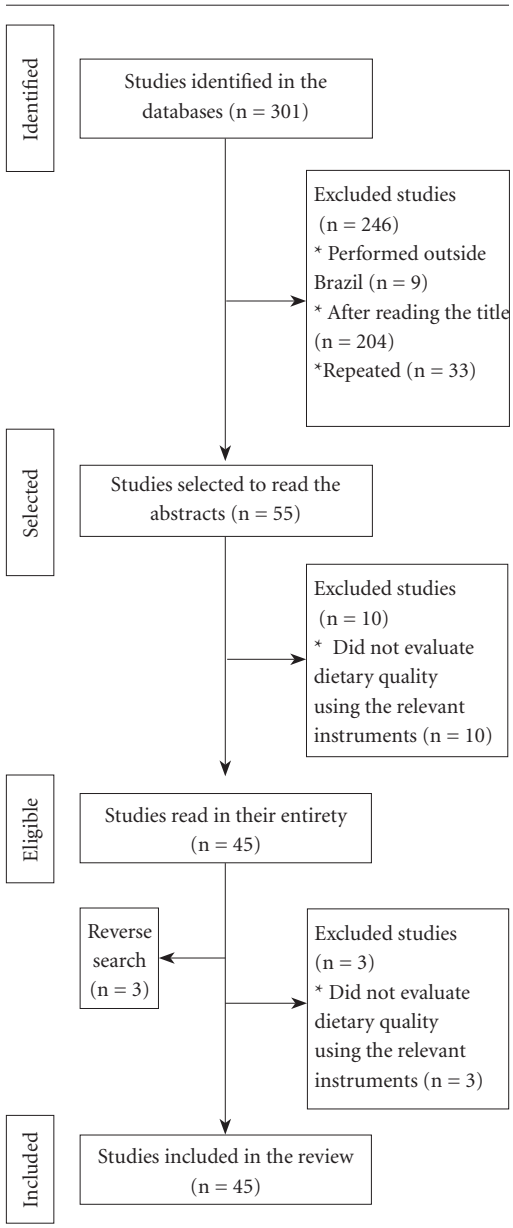

Figure 1. Stages of the systematic review.

The food consumption methods used to evaluate dietary quality were also assessed. Regarding dietary surveys, 36 studies (80%) used a 24-hour recall; three used a food frequency questionnaire (FFQ); one study used food history; and five studies used more than one food survey. Barbosa et al.[20] used food history, direct food weighing and food registration; Domene et al.[31] used direct food weighing and 24-hour recall; Sampaio

Chart 1. Description of the methodology used in the evaluation of dietary quality in Brazilian studies

Reference	Sample unit	Index used	Methodology used to assess dietary quality	
			Items in index	Scoring
Fisberg et al.[11]	50 elderly people, adults, adolescents and children	Adapted IQD [4]	10 items	Each component scored from 0-10, with IQD varying from 0-100; classification of dietary quality[11]
Barbosa et al.[20]	20 children in philanthropic creche	HEI[4]	10 items	Each component scored from 0-10, with HEIvarying from 0-100; classification of dietary quality[5]
Domene et al.[31]	94 children living in areas of poverty	HEI[4]	10 items	Each component scored from 0-10, with HEI varying from 0-100; classification of dietary quality[5]
Fisberg et al.[37]	3,454 adults	Adapted HEI [11]	10 items	Each component scored from 0-10, with HEI varying from 0-100; classification of dietary quality[5]
Godoy et al.[32]	437 adolescents	Adapted IQD [11]	10 items	Each component scored from 0-10, with IQD varying from 0-100; classification of dietary quality[5]
Sampaio et al.[21]	35 pre-school children (aged 2-3)	HEI	10 items	Each component scored from 0-10, with HEI varying from 0-100; classification of dietary quality[5]
Duran et al.[45]	56 HIV positive adults	Adapted HEI[19]	10 items	Each component scored from 0-10, with HEI varying from 0-100; classification of dietary quality[5]
Gomes et al.[33]	295 women (aged 20-50)	Adapted HEI[5]	10 items	Each component scored from 0-10, with HEI varying from 0-100; classification of dietary quality[5]
Morimoto et al.[56]	425 adults and 639 elderly people	Adapted IQD [11]	10 items	Each component scored from 0-10, with IQD varying from 0-100; classification of dietary quality[5]
Mota et al.[13]	502 people	Adapted HEI[4]	12 items	Each component scored from 0-10, with HEI varying from 0-120; classification of dietary quality[13]
Santos et al.[14]	67 people with type 2 diabetes	HEI[4]	10 items	Each component scored from 0-10, with HEI varying from 0-100; classification of dietary quality[5]
Andrade et al.[34]	1,584 people aged 12-20	Adapted HEI[11]	10 items	Each component scored from 0-10, with HEI varying from 0-100; classification of dietary quality[5]
Jaime et al.[22]	737 adults	Adjusted IQD [4]	10 items	Each component scored from 0-10, with IQD varying from 0-100
Portero-McLellan et al.[50]	448 adults (aged 35-85)	Adapted HEI[13]	12 items	Each component scored from 0-10, with HEI varying from 0-120
Previdelli et al.[38]	202 workers in a cosmetics factory	Adapted HEI[19]	10 items	Each component scored from 0-10, with HEI varying from 0-100; classification of dietary quality[5]
Tardivo et al.[46]	173 post-menopausal women	HEI[4]	10 items	Each component scored from 0-10, with HEI varying from 0-100; classification of dietary quality[5]
Vitolo et al.[23]	345 pre-school children (aged 3-4)	HEI[4]	10 items	Each component scored from 0-10, with HEI varying from 0-100; classification of dietary quality[5]
Felippe et al.[15]	100 adults and elderly people exposed (or not) to dietary re-education	Adapted HEI[13]	12 items (adjusted for 1,000 Kcal)	Each component scored from 0-10, with HEI varying from 0-120; classification of dietary quality[13]
Previdelli et al.[12]	2,298 adolescents, adults and elderly people	Revised IQD	12 items (adjusted for 1,000 Kcal)	Stratified components scored from 0-5, non-stratified components from 0-10 andFats_SA from 0-20
Santos et al.[24]	30 overweight women	Adapted HEI[11]	10 items	Each component scored from 0-10, with HEI varying from 0-100
Silva et al.[47]	246 people with (and without) metabolic syndrome	HEI[4]	10 items	Each component scored from 0-10, with HEI varying from 0-100; classification of dietary quality[5]
Costa et al.[39]	169 women who practised physical activity	Adapted IQD [4,11]	10 items	Each component scored from 0-10, with IQD varying from 0-100; classification of dietary quality[5]

it continues

Chart 1. continuation

Reference	Sample unit	Index used	Methodology used to assess dietary quality	
			Items in index	Scoring
Louzada et al.[40]	288 elderly people	HEI[4]	12 items	Stratified components scored from 0-5, non-stratified components from 0-10 and Fats_SA from 0-20; classification of dietary quality[5]
Assumpção et al.[41]	409 adolescents (aged 12-19) in an urban area	Adapted IQD [11,20]	10 items	Each component scored from 0-10, with IQD varying from 0-100; dietary quality in quartiles with the first quartile representing the worst quality
Carvalho et al.[25]	195 adults and 291 elderly people who participated in a health survey	Revised Brazilian IQD [12]	12 items (adjusted for 1,000 Kcal)	Stratified components scored from 0-5, non-stratified components from 0-10 and Fats_SA from 0-20
Melendez-Araújo et al.[18]	64 pre-operational obese patients with nutritional intervention	HEI adapted for Brazil[13]	12 items	Each component scored from 0-10, with HEI varying from 0-100; classification of dietary quality[13]
Andrade et al.[26]	2,375 people aged over 12 who participated in a health survey	Revised IQD [12]	12 items (adjusted for 1,000 Kcal)	Stratified components scored from 0-5, non-stratified components from 0-10 and Fats_SA from 0-20
Gorgulho et al.[51]	834 adolescents, adults and elderly people who participated in a health survey	Revised IQD [12]	12 items	Stratified components scored from 0-5, non-stratified components from 0-10 and Fats_SA from 0-20
Lima et al.[35]	747 recipients of the *Bolsa Família* program	Adapted IQD [4,11]	10 items	Each component scored from 0-10, with IQD varying from 0-100; classification of dietary quality[5]
Loureiro et al.[17]	195 adults (aged 20-50)	Revised IQD [4]	11 items	Stratified components scored from 0-5, non-stratified components from 0-10 and Fats_SA from 0-20
Malta et al.[27]	73 elderly people who used the public health system	HEI adapted for Brazil[13]	12 items	Each component scored from 0-10, with HEI varying from 0-120; classification of dietary quality[13]
Rauber et al.[36]	345 children (aged 3-4)	Adapted HEI[4]	10 items	Each component scored from 0-10, with HEI varying from 0-100; classification of dietary quality[5]
Tavares et al.[28]	75 nursing mothers	HEI[4]	10 items	Each component scored from 0-10, with HEI varying from 0-100; classification of dietary quality[13]
Almeida et al.[52]	242 pre-school children who benefited from the *Bolsa Família* program	Adapted IQD [4,11]	10 items	Each component scored from 0-10, with IQD varying from 0-100; classification of dietary quality[11]
Assumpção et al.[42]	1,509 people who participated in a health survey	Revised IQD [12]	12 items	Stratified components scored from 0-5, non-stratified components from 0-10 and Fats_SA from 0-20
Ceccato et al.[55]	190 women with breast cancer	Revised HEI[12]	12 items (adjusted for 1,000 Kcal)	Stratified components scored from 0-5, non-stratified components from 0-10 and Fats_SA from 0-20
Closs et al.[53]	186 elderly people receiving geriatric care	Adapted IQD [11]	10 items	Each component scored from 0-10, with IQD varying from 0-100; classification of dietary quality[5]
Monfort-Pires et al.[43]	204 people who participated in a program to prevent type 2 diabetes	Revised HEI [12]	12 items (adjusted for 1,000 Kcal)	Stratified components scored from 0-5, non-stratified components from 0-10 and Fats_SA from 0-20
Piovesan et al.[54]	80 people with metabolic syndrome	Adapted IQD [4,11]	10 items	Each component scored from 0-10, with IQD varying from 0-100; classification of dietary quality[11]

it continues

Chart 1. continuation

Reference	Sample unit	Index used	Methodology used to assess dietary quality	
			Items in index	Scoring
Rauber et al.[29]	671 children	Adapted HEI[4]	10 items	Each component scored from 0-10, with HEI varying from 0-100; classification of dietary quality[5]
Rauber et al.[30]	652 children	Adapted HEI [4]	10 items	Each component scored from 0-10, with HEI varying from 0-100; classification of dietary quality[5]
Rodrigues et al.[48]	100 women with polycystic ovary syndrome	Revised HEI [12]	12 item (adjusted for 1,000 Kcal)	Stratified components scored from 0-5, non-stratified components from 0-10 and Fats_SA from 0-20; classification of dietary quality[5]
Ventura et al.[49]	215 post-menopausal women	Adapted HEI[11]	10 items (adjusted for 1,000 Kcal)	Each component scored from 0-10, with IQD varying from 0-100; classification of dietary quality[11]
Wendpap et al.[44]	1,326 adolescents (aged 10-14)	Revised IQD [3,28]	12 items (adjusted for 1,000 Kcal)	Stratified components scored from 0-5, non-stratified components scored from 0-10 and Fats_SA from 0-20; scoring equal to or higher than p75 indicative of better dietary quality
Tanaka et al.[19]	88 adolescents with HIV/Aids in a pediatric hospital	IQD adapted for Brazil	12 items	Each component scored from 0-10, with IQD varying from 0-100

HEI: Healthy Eating Index; IQD: Dietary Quality Index; Fats_SA: solid fats, sugar and alcohol; TEV: total energetic value. Classification of dietary quality: Bowman et al.[5]: <51 = inadequate, 51-80 = requires improvement, >80 = adequate; Fisberg et al.[11]: < 40 = inadequate, 41-64 = requires improvement, > 65 = adequate; Mota et al.[13]: < 71 = inadequate, 71-100 = requires improvement, > 100 = adequate.

et al.[21] used food history, food registration and direct food weighing; Tavares et al.[28] evaluated consumption using a 24-hour recall and food frequency questionnaire; and Piovezan et al.[54] used a 24-hour recall supplemented by two food records.

As shown by the instrument used to define portions, 21 studies only used Brazilian instruments; five only used international instruments; and five defined portions by using a combination of instruments used in Brazil and internationally. A total of 14 articles did not mention the instrument that was used.

The instruments used to calculate nutrients were not mentioned in six studies; 17 researchers only cited the software used, without indicating which food composition table was chosen; 12 used a combination of Brazilian and international tables; eight only used Brazilian instruments to assess nutritional composition; and two studies only used international instruments.

Regarding the separation of the individual factors used in food preparation, 60% of the studies (n = 27) did not mention this factor; 40% (n = 18) mentioned that they did, but only five of them cited the instrument used to breakdown recipies[20,27,32,35,55].

Discussion

Dietary quality has been evaluated in Brazilian studies using different methodologies; although they are based on the same instrument, the Healthy Eating Index (HEI), they frequently use different nomenclatures. Some researchers use the term Healthy Eating Index[13-15,18-21,23,24,27-31,33,34,36-38,40,42,45-47,50,52-54], while other studies refer to the Dietary Quality Index[11,12,17,22,25,26,32,35,39,41,43,44,48,49,51,55,56]. Some authors referred to using the Dietary Quality Index when they published in Brazilian journals and the Healthy Eating Index when they published in international journals, reinforcing the lack of standardization in relation to nomenclatures regarding indices. Outside Brazil, the naming of indices based on the HEI tends to follow the original, given that most of the latter studies are written in English.

It is worth mentioning that the internationally-known IQD is not based on the HEI and has different characteristics, such as the evaluation of calcium intake rather than milk and dairy products. The IQD also considers protein intake rather than simply foods containing protein; it evalu-

ates the intake of fruits and vegetables as a single item, as well as the intake of cereals and legumes; it does not consider alcohol intake and it assigns a higher score to a lower quality diet[57-60].

Another important consideration is that the revised IQD, which was proposed by Haines et al.[58], contained different characteristics from the HEI, such as proportionality between food groups, the evaluation of the intake of specific micronutrients (calcium and iron) and the absence of the food components of milk its derivatives, and protein foods[59,60].

Therefore, naming dietary quality instruments that were adapted from the HEI as IQD or revised-IQD is inappropriate since these instruments contain different items and recommendations.

Regarding the items contained in the dietary quality instruments covered by this review, although the majority used ten items, as proposed in the original version[4], many authors adapted these items in the following ways: 1) cereal items were denominated as cereals, breads and roots ; cereals, breads, roots and tubers; grains or only cereals, as well as total cereals and whole cereals, as suggested[9]; 2) meat items were denominated as meat and eggs; meat, eggs and legumes; meat and beans; or simply meat; 3) vegetables were denominated as greens, vegetables and legumes, and some studies referred to total vegetables, and dark green and orange vegetables as suggested[9]; 4) the inclusion of beans or legumes in 21 of the evaluated studies highlighted the importance of this group of foods in the Brazilian diet; 5) the replacement of sodium by dietary fiber[45]; 6) and the use of only a few specific items in the analyses[17,25]. These different denominations of items, without clear specification of the foods included in each component of the index, made it difficult to compare the results.

It should be emphasized that the most current indexes[3,7] recommended the use of 12 food items to evaluate dietary quality. Indices that include more food items are able to reflect food patterns more comprehensively[61].

The instrument used to evaluate dietary quality in most of the studies was the HEI proposed by Kennedy et al.[4], including those published after the reviews of this instrument in 2005 and 2010. None of the articles used HEI-2010 to evaluate dietary quality. It should be emphasized that the use of updated instruments is important because the revised HEI incorporated the inclusion of items such as whole grains; the separation of vegetables; the separation of fat types; an emphasis on calories derived from solid fats, alcohol and sugar; an assessment of the dietary quality of individuals older than two years and pregnant and lactating women; as well establishing an energy density adjustment per 1000 Kcal for food and sodium components, characterizing dietary quality[10]. Revised indices show stronger associations between dietary quality and health status than older indices, thus justifying their use[8].

Subsequent to the revisions of the index, the classification of the total score for dietary quality is no longer recommended because it can mask which food or nutrient components require improvement in terms of quality[8-10]. Nevertheless, the present review found that most of the studies published after this recommendation still classified dietary quality as either bad, adequate or in need of modifications, following the criteria proposed by Bowman et al.[5] and Mota et al.[13]. It should be noted that in two articles, dietary quality was not classified following established cutoff points but rather in quartiles[41] and percentiles[44]. This alternative evaluation has been suggested by Guenther et al.[9] when it is intended to evaluate the total score obtained for a studied population in order to distinguish the extremes of scoring and the relationship between dietary quality and the disease in question, without classifying it.

Dietary assessment prior to the evaluation of dietary quality was also heterogeneous: the studies used different dietary surveys (24-hour recall, direct food weighing, food records and food history) to analyze single or average values. It is known that dietary surveys have advantages and limitations that can interfere with the quality of dietary data[60]. Another crucial point in dietary analysis is the use of composition tables, software and complementary instruments that help to define the portion that is consumed. In this review it was observed that some studies did not detail the use of the latter, although some did mention which instrument was used.

Information regarding portion definition and the details of recipes are relevant in assessing dietary quality, but they were not considered in some studies. Regarding portions, 31.1% of the studies did not mention any instrument used to define them. It should be emphasized that not all the researchers used Brazilian instruments, a fact that may have impaired this evaluation because different countries have different eating habits. The definition of portions according to the Food Guide for the Brazilian Population would be the most appropriate in terms of Brazil[62].

Adaptations in the instrument used to evaluate dietary quality are recommended for use

in specific subpopulations, mainly in relation to portion sizes and recommendations, in order to take into consideration any relevant specificities[4,9,10,13].

Most of the selected publications did not mention a breakdown of food preparations. However, to better classify the components of the HEI, it is recommended to itemize homemade preparations in terms of their respective ingredients according to dietary guidelines[20].

These dietary assessment indices are useful tools to analyze the dietary and nutritional characteristics consumed by individuals and populations, as well as highlighting the relationship between dietary quality and the risks of diseases. However, the lack of standardization of methodologies makes it difficult to compare studies and to evaluate the overall diet of the Brazilian population.

Dissertations and theses were not included In this review, which could represent a limitation of the study, due to the lack of analysis of any study that might have assessed dietary quality. However, in order to minimize this bias, we performed a reverse search to include published studies that were not previously selected.

Final considerations

In most of the evaluated studies there was no standardization regarding the methodologies used to assess dietary quality, including the denomination of the index that was used. These differences in relation to nomenclatures and methodologies made it difficult to compare the studies of dietary quality.

This review is innovative in that it addresses methodological differences regarding the use of indices in Brazilian studies in relation to different age groups. Therefore, it is recommended that when researchers investigate dietary quality they should analyze the instruments that are available in the scientific literature and always resort to original and revised materials before replicating methodologies.

The use of revised instruments should be prioritized because they have advantages in relation to previous editions. The adaptation of indices according to the consumption characteristics of specific populations is advisable, provided that the methodological criteria are followed and clearly described.

Collaborations

DC Morais, LFS Moraes, DCG Silva and CA Pinto worked on the design, writing and critical review of this review. JF Novaes worked on the critical review.

References

1. Monteiro CA, Levy RB, Claro RM, Castro IRR, Cannon G. Creasing consumption of ultra-processed foods and likely impact on human health: evidence from Brazil. *Public Health Nutr* 2011; 14(1):5-13.
2. Wirt A, Collins CE. Diet quality – what is it and does it matter? *Public Health Nutr* 2009; 12(12):2473-2492.
3. Guenther PM, Reedy J, Krebs-Smith SM, Reeve BB, Basiotis PP. *Development and Evaluation of the Healthy Eating Index-2005: Technical Report*. Washington: Center for Nutrition Policy and Promotion, U.S. Department of Agriculture; 2007.
4. Kennedy ET, Ohls J, Carlson S, Fleming K. The Healthy Eating Index: design and applications. *J Am Diet Assoc* 1995; 95(10):1103-1108.
5. Bowman SA, Linn M, Gerrior SA, Basiotis PP. *The Healthy Eating Index, 1994-96*. Washington: US Department of Agriculture; 1998.
6. U.S. Department of Agriculture, U.S. Department of Health and Human Services Dietary. *Guidelines for Americans*. 7th ed. Washington: U.S. Government Printing Office; 2010.
7. Guenther PM, Casavale KO, Reedy J, Kirkpatrick SI, Hazel AB, Hiza HAB, Kuczynski KJ, Kahle LL, Krebs-Smith SM. Update of the Healthy Eating Index: HEI-2010. *J Acad Nutr Diet* 2013; 113(4):569-580.
8. Dixon LB. Updating the Healthy Eating Index to reflect current dietary guidance. *J Am Diet Assoc* 2008; 108(11):1837-1842.
9. Guenther PM, Reedy J, Krebs-Smith SM. Development of the Healthy Eating Index-2005. *J Am Diet Assoc* 2008; 108(11):1896-1901.
10. Guenther PM, Reedy, J, Krebs-Smith SM, Reeve BB. Evaluation of the Healthy Eating Index-2005. *J Am Diet Assoc* 2008; 108(11):1854-1864.
11. Fisberg RM, Slater B, Barros RR, Lima FD, Carandina L, Barros MBA, Goldbaum M. Índice de qualidade da dieta: avaliação e aplicabilidade. *Rev Nutr* 2004; 17(3):301-318.
12. Previdelli AN, Andrade SC, Pires MM, Ferreira SR, Fisberg RM, Marchioni DM. Índice de Qualidade da Dieta Revisado para a população brasileira. *Rev Saude Publica* 2011; 45(4):794-798.
13. Mota JF, Rinaldi A, Pereira A, Maesta N, Scarpin M, Burini R. Adaptação do índice de alimentação saudável ao guia alimentar da população brasileira. *Rev Nutr* 2008; 21(5):545-552.
14. Santos CRB, Gouveia LAV, Portella ES, Avila SS, Soares EA, Lanzillotti HS. Índice de Alimentação Saudável: avaliação do consumo alimentar de diabéticos tipo 2. *Nutrire: Rev Soc Bras Alim Nutr* 2009; 34(1):115-129.
15. Felippe F, Balestrin L, Silva FM, Schneider AP. Qualidade da dieta de indivíduos expostos e não expostos a um programa de reeducação alimentar. *Rev Nutr* 2011; 24(6):833-844.
16. Moher D, Liberati A, Tetzlaff J, Altman DG. Preferred Reporting Items for Systematic Reviews and Meta-Analyses: The PRISMA Statement. *Ann Int Med* 2009; 151(4):264-270.
17. Loureiro AS, Silva RMVG, Rodrigues PRM, Pereira RA, Wendpap LL, Ferreira MG. Diet quality in a sample of adults from Cuiabá (MT), Brazil: Association with sociodemographic factors. *Rev Nutr* 2013; 26(4):431-441.
18. Melendez-Araújo MS, Arruda SLM, Kelly EO, Carvalho KMB. Preoperative Nutritional Interventions in Morbid Obesity: Impact on Body Weight, Energy Intake, and Eating Quality. *Obes Surg* 2012; 22(12):1848-1854.
19. Tanaka LF, Latorre MRDO, Silva AM, Konstantyner TCRO, Mendes EC, Marques HHSM. Poor diet quality amog Brazilian adolescentes with HIV/AIDS. *Jornal de Pediatria* 2015; 91(2):152-159.
20. Barbosa RMS, Carvalho CGN, Franco VC, Salles-Costa R, Soares EA. Avaliação do consumo alimentar de crianças pertencentes a uma creche filantrópica na Ilha de Paquetá, Rio de Janeiro, Brasil. *Rev Bras Saude Mater Infant* 2006; 6(1):127-134.
21. Sampaio RMB, Serrão LH, Abreu SE. Assessment of the global diet quality of preschool children at a non-profit day care center: comparison at two time points. *Rev Chil Nutr* 2006; 33(3):473-479.
22. Jaime PC, Bandoni DH, Duran ACFL, Fisberg RM. Diet quality index adjusted for energy requirements in adults. *Cad Saude Publica* 2010; 26(11):2121-2128.
23. Vitolo MR, Rauber F, Campagnolo PDB, Feldens CA, Hoffman DJ. Maternal Dietary Counseling in the First Year of Life Is Associated with a Higher Healthy Eating Index in Childhood. *J Nutr* 2010; 140(11):2002-2007.
24. Santos GG, Sousa JB, Oliveira DNB, Ribeiro NC. Avaliação Da Qualidade Da Dieta De Mulheres Atendidas Em Uma Clínica Escola. *Ensaios e Ciência: Ciências Biológicas, Agrárias e da Saúde* 2011; 15(4):37-52.
25. Carvalho AM, César CLG, Fisberg RM, Marchioni DML. Excessive meat consumption in Brazil: diet quality and environmental impacts. *Public Health Nutr* 2012; 16(10):1893-1899.
26. Andrade SC, Previdelli NA, Marchioni DML, Fisberg RM. Avaliação da confiabilidade e validade do Índice de Qualidade da Dieta Revisado. *Rev Saude Publica* 2013; 47(4):675-683.
27. Malta MB, Papini SJ, Corrente JE. Avaliação da alimentação de idosos de município paulista – aplicação do Índice de Alimentação Saudável. *Cien Saude Colet* 2013; 18(2):377-384.
28. Tavares MP, Devincenzi UM, Sachs A, Abrão ACFV. Estado nutricional e qualidade da dieta de nutrizes em amamentação exclusiva. *Acta Paul Enferm* 2013; 26(3):294-298.
29. Rauber F, Hoffman DJ, Vitolo MR. Diet quality from pre-school to school age in Brazilian children: a 4-year follow-up in a randomised control study. *Br J Nutr* 2014; 111(3):499-505.
30. Rauber F, Louzada MLC, Vitolo MR. Healthy Eating Index Measures Diet Quality of Brazilian Children of Low Socioeconomic Status. *J Am Coll Nutr* 2014; 33(1):26-31.
31. Domene SMA, Jackix EA, Raposo HF. Adaptação das diretrizes alimentares para a população brasileira e o estabelecimento do índice de alimentação saudável para pré-escolares de 2 a 6 anos. *Nutrire: Rev Soc Bras Alim Nutr* 2006; 31(2):75-90.
32. Godoy FC, Andrade SC, Morimoto JM, Carandina L, Goldbaum M, Barros MBA, CLG Cesar, Fisberg RM. Índice de qualidade da dieta de adolescentes residentes no distrito do Butantã, município de São Paulo, Brasil. *Rev Nutr* 2006; 19(6):663-671.

33. Gomes ALC, Campino ACC, Cyrillo DC. Índice de alimentação saudável entre mulheres de diferentes estratos sociais: o caso da Vila Formosa. *Nutrire: Rev Soc Bras Alim Nutr* 2008; 33(2):87-97.
34. Andrade SC, Barros MBA, Carandina L, Goldbaum M, Cesar CLG, Fisberg RM. Dietary quality index and associated factors among adolescents of the state of Sao Paulo, Brazil. *J Pediatr* 2010; 156:456-460.
35. Lima FEL, Fisberg RM, Uchimura KY, Picheth, T. Programa Bolsa-Família: qualidade da dieta de população adulta do município de Curitiba, PR. *Rev Bras Epidemiol* 2013; 16(1):58-67.
36. Rauber F, Costa Louzada ML, Feldens CA, Vitolo MR. Maternal and family characteristics associated with the Healthy Eating Index among low socioeconomic status Brazilian children. *J Hum Nutr Diet* 2013; 26(4):369-379.
37. Fisberg RM, Morimoto JM, Slater B, Barros MBA, Carandina L, Goldbaum M, Oliveira Latorre MR, César CL. Dietary quality and associated factors among adults living in the state of São Paulo, Brazil. *J Am Diet Assoc* 2006; 106(12):2067-2072.
38. Previdelli AN, Lipi M, Castro MA, Marchioni DML. Dietary Quality and Associated Factors among Factory Workers in the Metropolitan Region of São Paulo, Brazil. *J Am Diet Assoc* 2010; 110(5):786-790.
39. Costa D, Reis BZ, Vieira DAS, Costa JO, Teixeira PDS, Raposo OFF, Lima FEL, Mendes-Netto RS. Índice de qualidade da dieta de mulheres usuárias de um programa de atividade física regular "Academia da Cidade", Aracajú, SE. *Rev Nutr* 2012; 25(6):731-741.
40. Louzada MLC, Durgant PC, De Marchi RJ, Hugo FN, Hilgert JB, Padilha PDMP, Antunes MT. Healthy eating index in southern brazilian older adults and its association with socioeconomic, behavioral and health characteristics. *J Nutr Health Aging* 2012; 16(1):3-7.
41. Assumpção D, Barros MBA, Fisberg RM, Carandina L, Goldbaum M, Cesar CLG. Qualidade da dieta de adolescentes: estudo de base populacional em Campinas, SP. *Rev Bras Epidemiol* 2012; 15(3):605-616.
42. Assumpção D, Domene SMA, Fisberg RM, Barros MBA. Qualidade da dieta e fatores associados entre idosos: estudo de base populacional em Campinas, São Paulo, Brasil. *Cad Saude Publica* 2014; 30(8):1680-1694.
43. Monfort-Pires M, Folchetti LD, Previdelli AN, Siqueira-Cantania A, Barros CR, Ferreira SRG. Healthy Eating Index is associated with cretain markers of inflammation and insulin resistance but not with lipid profile in individuals at cardiometabolic risk. *Appl Physiol Nutr Metab* 2104; 39(4):497-502.
44. Wendpap LL, Ferreira MG, Rodrigues PRM, Pereira RA, Loureiro AS, Gonçalves-Silva RMV. Qualidade da dieta de adolescentes e fatores associados. *Cad Saude Publica* 2014; 30(1):97-106.
45. Duran ACFL, Almeida LB, Segurado AAC, Jaime PC. Diet quality of persons living with HIV/AIDS on highly active antiretroviral therapy. *J Hum Nutr Diet* 2008; 21(4):346-350.
46. Tardivo AP, Nahas-Neto J, Nahas EAP, Maesta N, Rodrigues MAH, Orsatti FL. Associations between healthy eating patterns and indicators of metabolic risk in postmenopausal women. *Nutr J* 2010; 9(64):1-9.
47. Silva KF, Prata A, Cunha DF. Frequency of metabolic syndrome and the food intake patterns in adults living in a rural area of Brazil. *Rev Soc Bras Med Trop* 2011; 44(4):425-429.
48. Rodrigues AMS, Martins LB, Franklin AMT, Candido AL, Santos LC, Ferreira AVM. Poor quality diet is associated with overweight status and obesity in patients with polycystic ovary syndrome. *J Hum Nutr Diet* 2014; 28(Supl. 2):94-101.
49. Ventura DA, Fonseca VM, Ramos EG, Marinheiro LPF, Souza RAG, Chaves CRMM, Peixoto MV. Association between quality of the diet and cardiometabolic risk factors in postmenopausal women. *Nutr J* 2014; 13(1):121-131.
50. Portero-McLellan KC, Pimentel GD, Corrente JE, Burini RC. Association of fat intake and socioeconomic status on anthropometric measurements of adults. *Cad Saúde Colet* 2010; 18(2):266-274.
51. Gorgulho BM, Fisberg RM, Marchioni DML. Nutritional quality of major meals consumed away from home in Brazil and its association with the overall diet quality. *Prev Med* 2013; 57(2):98-101.
52. Almeida IS, Sperandio N, Priore SE. Qualidade da dieta de pré-escolares beneficiados pelo Programa Bolsa Família, segundo situação de Segurança Alimentar do domicílio. *Nutrire: Rev Soc Bras Alim Nutr* 2014; 39(3):297-305.
53. Closs VE, Feoli AMP, Gomes I, Schwanke CHA. Healthy eating index of elderly: description and association with energy, macronutrients and micronutrients intake. *Arch Latinoam Nutr* 2014; 64(1):34-41.
54. Piovesan CH, Macagnan FE, Bodanese LC, Feoli AM. Dietary quality improvement after a short-term nutritional counseling program in individuals with metabolic syndrome. *Arch Latinoam Nutr* 2014; 64(2):91-98.
55. Ceccato V, Di Pietro PF, Previdelli NA, Vieira FGK, Schiavon CC, Engel R, Lizane Cardoso A, Altenburg de Assis MA, Gilberto Crippa C, Gonzalez Chica DA. Brazilian Healthy Eating Index Revised (BHEI-R) of women before and during adjuvante treatment for breast cancer. *Nutr Hosp* 2014; 30(5):1101-1109.
56. Morimoto JM, Latorre MRDO, César CLG, Carandina L, Barros MBA, Goldbaum M, Fisberg RM. Fatores associados à qualidade da dieta de adultos residentes na Região Metropolitana de São Paulo, Brasil, 2002. *Cad Saude Publica* 2008; 24(1):169-178.
57. Pattersson RE, Haines OS, Popkin BM. Diet quality index: capturing a multidimensional behavior. *J Am Diet Assoc* 1994; 94(1):57-64.
58. Haines PS, Siega-Riz AM, Popkin BM. The diet quality índex revised: a measurement instrument for populations. *J Am Diet Assoc* 1999; 99(6):697-704.
59. Cervato AM, Vieira VL. Índices dietéticos na avaliação da qualidade global da dieta. *Rev Nutr* 2003; 16(3):347-55.
60. Volp ACP, Alfenas RCG, Costa NMB, Minim VPR, Stringueta PC, Bressan J. Índices dietéticos para avaliação da qualidade de dietas. *Rev Nutr* 2010; 23(2):281-295.
61. Previato HDRA, Volp ACP, Freitas RN. Avaliação da qualidade da dieta pelo Índice de Alimentação Saudável e suas variações: uma revisão bibliográfica. *Nutr. Clin. Diet. Hosp*. 2014; 34(2):88-96.
62. Brasil. Ministério da Saúde (MS). *Guia alimentar para a população brasileira: promovendo a alimentação saudável*. Brasília: MS; 2006.

Article submitted 10/09/2015
Approved 21/01/2016
Final version submitted 23/01/2016