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Assessment of the healthy dietary diversity of a main meal in a self-service restaurant

A pilot study

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Abstract

Purpose – The purpose of this paper is to present a first proposal of a healthy dietary diversity index to evaluate meals in self-service restaurants.

Design/methodology/approach – This was a cross-sectional, descriptive pilot study in a Brazilian buffet-style restaurant. The study group was selected by systematic sampling and consisted of 678 individuals aged 16-81 years, who were regular diners at a selected restaurant during lunchtime. Photographs were used to assess food choices and a sociodemographic questionnaire was administered to the subjects. A healthy dietary diversity model was created following WHO recommendations and the Brazilian Food Guide. A consensus workshop was conducted with experts to discuss and classify certain dishes as more or less healthy (high/low energy density). The model attributed negative (-3.0-0.0) and positive (0.0-12.0) scores to different food groups. Higher scores meant greater diversity on the plate, and therefore a greater chance of a healthy meal (= 9.0), while a lower score reflected a higher variety of energy-dense foods, such as fried dishes (= 6.0).

Findings – Most diner's plates (65.3 per cent) obtained low diversity score indexes (= 6) and were considered inadequate, represented the dishes where intake should be controlled from a nutritional viewpoint (over caloric meal). There was a significant association between healthy diversity scores (= 9.0) and low variety of high energy density dishes on the plates.

Originality/value – This method of assessing the healthy dietary diversity of a main meal could be tested as an innovative model for investigating the food choices of individuals who eat away from home.

Keywords Meals, Restaurants, Dietary assessment, Dietary diversity, Food choices

Paper type Research paper



Introduction

The high prevalence of overweight, obesity, and non-communicable chronic diseases is considered important public health issues throughout the world (Drewnowski, 2000; Popkin, 2004; Popkin *et al.*, 2012). The World Health Organization reports that economic growth, modernization, urbanization and food globalization are related to what may be seen as an obesity epidemic. Furthermore, as rural populations migrate to cities, diets rich in complex carbohydrates are replaced by diets that at first seem more varied, but are in fact high in total and saturated fats and sugars (World Health Organization, 2003, 2006; Malik *et al.*, 2013).

Studies have shown that the habit of eating away from home can result in higher energy and cholesterol intakes, mostly from saturated fats, trans fatty acids, added sugar and sodium. This can increase body mass index and the risk of developing chronic diseases (Paeratakul *et al.*, 2003; Bowman and Vinyard, 2004; Kant and Graubard, 2004; Mehta and Chang, 2008; Duffey *et al.*, 2009; Fulkerson *et al.*, 2011; Lachat *et al.*, 2012).

The popularity of self-service restaurants is increasing throughout the world. In Brazil, a popular type of self-service restaurant is the buffet-by-weight style, so called kilo restaurant. In this system a large range of dishes is available to diners who serve themselves from a buffet, creating their own meal. Then, the plate of food is weighed on a scale and consumers pay the corresponding value. These buffet-style restaurants seem to have sprung up to meet the growing need for quicker and more varied meals. It is believed that the ability to select a meal according to preference, together with the variety on offer, allows healthier choices (Santos *et al.*, 2011).

Studies have show that dietary variety and/or diversity are healthy and related to diet quality (Kant *et al.*, 1993; Drewnowski *et al.*, 1997; Dixon *et al.*, 2001). Eating a more varied diet is associated with a higher intake of macro and micronutrients, as well as higher nutritional adequacy and diet quality (Steyn *et al.*, 2006; Azadbakht and Esmailzadeh, 2011).

However, a recent review showed that when a meal contains a greater variety of foods, humans consume about 22 per cent more energy compared to when only one food is available. Such studies suggest that the increasing variety of energy-dense food may be a major contributor to the increasing worldwide prevalence of obesity (McCory *et al.*, 2012). Dietary diversity and variety have long been accepted as a key element of a high quality diet. However, diets that contain a greater variety of energy-dense foods may also increase food intake and body weight. Therefore, public health messages should focus on improving dietary diversity in selective food items (Jayawardena *et al.*, 2013).

The development of tools that assess dietary diversity has been the focus of many studies worldwide (Krebs-Smith *et al.*, 1987; Kant *et al.*, 1991; Drewnowski *et al.*, 1997; Cox *et al.*, 1997; Foote *et al.*, 2004; Drescher *et al.*, 2007; Rauber *et al.*, 2012). Nevertheless, the developed indexes assess food intake over a certain period, from one to 15 days, using food recalls, food frequency questionnaires or a food-weighing method, and therefore are not suitable for assessing a single dish, such as a meal in self-service restaurant. A systematic review presents some studies that contemplate many of the necessary parameters for dish assessment. In this study the authors discuss the methods, instruments and parameters used for analysing the menu nutritionally and sensorially. However, there is no consensus on which is the best assessment protocol. The authors suggest that the planning of diverse and nutritionally balanced menus may be an important tool for the development of healthy eating practices (Ginani *et al.*, 2012).

This study proposed a new idea inspired by the importance of investigating the dietary diversity of meals consumed away from home, considering the variety of foods offered in self-service restaurants, and analysing ingredients and dish preparation. Hence, the aim was to assess the healthy dietary diversity of a main meal (lunch) consumed by diners at a self-service restaurant.

Method

An analytical cross-sectional pilot study was conducted with consumers having lunch in a restaurant serving buffet-by-weight, located in the southern region of Brazil. In this type of foodservice, consumers serve themselves from a buffet. Then, they weigh the plate containing the chosen foods on a scale that is tarred for the weight of the plate, paying only for the weight of the food chosen in relation to a kilogram price. This type of restaurant is common throughout Brazil (Rodrigues *et al.*, 2012).

Construction of a healthy dietary diversity index for a meal (DDI-M)

Consensus workshop. Considering the scarcity of studies on tools that assess the dietary diversity of a main meal in restaurants, a consensus workshop was conducted by adaptation of the Delphi method using an expert reference group (Fink *et al.*, 1984). Consensus methods offer systematic qualitative alternatives to assess and control inconsistencies in scientific information (Tammela, 2013). The purpose of the workshop was to discuss and consolidate the criteria for classifying foods as healthy or not (based on high or low energy density). Ten experts took part in the workshop, namely, graduates or professors working in the fields of basic and applied nutrition, registered dietitians experienced in food service management, and a consensus technique expert.

The materials prepared for the workshop were as follows: invitation letter with proposed meeting schedule, glossary with key words or terms necessary for understanding the technique set of explanations regarding the conduction of a consensus workshop, references used to prepare the material, in addition to the theoretical matrix itself. The workshop lasted four hours and was digitally recorded (Olympus, model DS-40). An open discussion took place, rather than filling out forms. After explanation, each item included in the document was discussed. At the end of the meeting all participants agreed with the results. From the discussion, the experts reached a consensus of views concerning the requirements to assess the diversity of a healthy eating meal at a self-service restaurant.

The model discussed in the consensus workshop was called DDI-M.

Restaurant selection

The selection of the location was intentional, aiming to guarantee a diverse range of dishes on the buffet and a heterogeneous clientele. The following inclusion criteria were considered: buffet-by-weight restaurant, downtown location, average pricing, served numerous foods and dishes and diversified clientele wide choice of foods and dishes. The study was conducted in a buffet-by-weight self-service restaurant located in the downtown area of a state capital in southern Brazil. The restaurant had to be located downtown because of the socio-demographic diversity of people that frequent the region. Price was also considered a relevant factor to ensure clientele diversity.

In total, 53 self-service restaurants located in the central area of the city were identified by consulting the municipal union of hotels, restaurants, bars, and similar businesses, local business yellow pages, and internet search sites. A survey of the

prices charged by the establishments was carried out by telephone; 15 restaurants were excluded from the sample because they were no longer in operation or were not buffet-by-weight services, leaving 38 restaurants to choose from. After separating the prices charged into quartiles, 19 restaurants that charged prices in the intermediate quartiles (second and third quartiles) were pre-selected for observation analyses (Rodrigues *et al.*, 2012).

In the observational analysis, trained observers evaluated the variety of dishes and clientele from the 19 buffets using specific forms, culminating with the selection of one restaurant. The selection considered the socio-demographic characteristics of sex and age, as well as the number, quality and variability of dishes on the buffet. The first restaurant chosen agreed to participate (Rodrigues *et al.*, 2012).

The selected restaurant served approximately 400 meals a day from Monday to Friday. There were 55 dishes on the buffet table, namely, 24 salads, four cold side dishes, 15 hot side dishes and 12 types of meat. Dishes served in the cold buffet were salads and cold side dishes. Salads consisted mainly of fruits, leafy greens and vegetables with <20 per cent carbohydrates in their composition. Vegetables were served cooked or raw and cut in a variety of ways. Cold side dishes consisted of dishes that contained ingredients other than fruits and vegetables, such as grains, pastas, bread, processed meat or starchy vegetables (potatoes, manioc and corn).

Participants

The predicted sample size was calculated to be representative of consumers from the selected restaurant, on weekdays in one month (weekends excluded). According to the average production of 400 meals per day at lunch and the average of 22 weekdays in the month, the population of consumers at the restaurant consisted of 8,800 individuals.

The minimum calculated sample size was 384 individuals for a confidence interval of 95 per cent, unknown prevalence, sampling error of 5 per cent, and data would have to be collected on ten different days to ensure meal and diner diversity. The study was approved by the local Research Ethics Committee, under protocol number 142/08.

Data collection

Data were collected on ten non-consecutive weekdays, during open lunch time (11:30-14:00), across two consecutive months in 2008. Diners were selected systematically with a random start. They were approached the moment their plates were weighed, which prevented the study from interfering with their food choices.

A picture of the given plate was taken by one collaborator while another administered a short socio-demographic questionnaire (gender, age, marital status and education level) to the diner. Diners were identified by number. If foods were overlaid on the plate, a collaborator would rearrange the plate to show the foods that were not visible in the picture.

Criteria for the classification of different dishes

Dishes were classified according to food group, subgroup, dish preparation and recommendations made by the WHO (World Health Organization (WHO), 2004), Brazilian Food Guide (Brazil Ministry of Health, 2008) and Brazilian Food Pyramid (Philippi *et al.*, 1999). Such recommendations aim at encouraging healthy eating, and all of them recommend restricting the consumption of energy-dense and nutrient-poor foods that are high in fat, sugar and salt, such as pastries, lasagne and deep-fried foods. The Brazilian Food Guide also recommends the consumption of traditional Brazilian staples, such as fruits, vegetables and the combination of rice and beans.

The food groups were: grains, breads, tubers, roots; vegetables and fruits; legumes (beans); and meats, including seafood, and eggs. The group containing oils and fats was not considered separately because of the difficulty of identifying them in a meal. Instead, they were considered ingredients. Dairy-based dishes were not included because Brazilians do not normally consume such foods during main meals, that is, during lunch or supper, and dessert consumption was not evaluated, because these were not included in the buffet-by-weight. Dishes were further classified into subgroups according to preparation method and, when necessary, according to the main added ingredient. In order to classify dishes as healthy or not, parameters used in previous studies were employed (Cassady *et al.*, 2004; Saelens *et al.*, 2007; Krukowski *et al.*, 2011a, b). Healthier items include those that are grilled, baked or broiled (as opposed to fried); nonfried vegetables; fruits without added sugar; low-fat items; whole-grain items; dishes not containing cheese or cream as a major ingredient; green salads dishes, unless their protein source does not follow the other guidelines (e.g. fried meat); and meat that is lower-fat or lower-calorie (Krukowski *et al.*, 2011a).

Identification and classification of the dishes on the plate

Identification and categorization of the dishes chosen by the diners began by recording the menu of the data collection days. A spreadsheet was then created with the list of all dishes in the menu and each received an identification number. They were then classified into groups and subgroups.

The groups and subgroups of the dishes were defined according to the classification criteria proposed by the present study from the consensus workshop, including the dish preparation and/or main ingredient. Foods where intake should be controlled, from a nutritional viewpoint (energy-dense food) were defined as those prepared with excessive quantities of oil or fat, such as fried, deep-fried and breaded dishes, and/or those with added ingredients high in sodium, sugar and fat (fruit preserves, pickles, sausages, high-fat sauces, processed meats, fried meats) (Veiros *et al.*, 2006; Elmslie *et al.*, 2012) (Figure 1).

Scoring

The DDI-M consists of four groups and 11 subgroups. The scores of the dishes were defined at the consensus workshop. The criteria for assessing the dietary diversity of a main meal were identified for each food group. The maximum score possible for each of the main groups is +3.0 (Table I).

In relation to the main dish preparations of each food group, the subgroups S1, S2, C1, C2, L1, P1 and P2 consisted of boiled, stewed, broiled, roasted and grilled dishes (where intake is recommended, according to the nutritional viewpoint). Meanwhile, subgroups S3, C3, L2 and P3 represented the dishes where intake should be controlled from a nutritional viewpoint (energy-dense foods) (WHO, 2004; Brazil Ministry of Health, 2008; Philippi *et al.*, 1999).

The only subgroup with a negative score is C3 (Table I), consisting of energy-dense foods such as fries, farofa (flavoured manioc flour roasted in oil or butter), pastel (deep fried pastry wrap with assorted fillings), lasagne, potato salad with mayonnaise, fritters, fried cassava, among others. For these dishes not to cancel out the other subgroups, they were analysed separately into two segments: positive index and negative index. Hence, the positive index is the sum of the dishes included in subgroups S1, S2, S3, C1, C2, L1, L2, P1, P2 and P3, whose maximum score is +12.0. The negative index is the sum of the dishes included in group C3, whose maximum score is -3.0.

GROUPS ^a	SUBGROUPS ^a
Salads (S)	(S1): Leafy greens (S2): Raw or cooked vegetables (S3): Vegetables with higher energy density ^b
Side dishes (C)	(C1): Grains and derivatives (whole) (C2): Grains and derivatives (refined) or whole but high energy density ^b (C3): Grains and derivatives, tubers (refined) with high energy density ^b
Legumes (L)	(L1): Without processed meat (L2): With processed meat
Meats / High-protein foods (P)	(P1): Seafood prepared with little or no fat or with vegetable-based sauces (P2): Lean meats (beef, pork, poultry...) prepared with little or no fat (P3): Meats and other high-protein foods with high energy density ^b

Notes: ^aThe groups and subgroups of the dishes were defined according to the classification criteria proposed by the present study from the consensus workshop, including the dish preparation and/or main ingredient; ^bhigh energy density were defined as those prepared with excessive quantities of oil or fat, such as fried, deep-fried and breaded dishes, and/or those with added ingredients high in sodium, sugar and fat (fruit preserves, pickles, sausages, high-fat sauces, processed meats, fried meats)

Figure 1.
Classification of the dishes according to food and dish preparation

Groups e subgroups	Desirable in a meal	Score by food item	Criteria Maximum subgroup score	Maximum and minimum group score
S1	1 type	+1.0	+1.0	
S2	2 types	+1.0	+2.0	0.0 a+3.0
S3	None	+0.5	+0.5	
C1	1 type	+3.0	+3.0	
C2	1 type	+1.0	+2.0**	-3.0 a+3.0
C3	None	-1.5	-3.0	
L1	1 type	+3.0	+3.0	0.0 a+3.0
L2	1 type	+1.0	+2.0	
P1	1 type ^a	+3.0	+3.0	
P2	1 type ^a	+2.5	+3.0 ^b	0.0 a+3.0
P3	1 type ^a	+1.0	+1.0	

Notes: ^aFor this group it is desirable that at least one of the food types is present and they are not cumulative for the index; ^bfor subgroups C2 and P2, it is desirable that one of the types of food of each subgroup be present. When more than one type is present, the score increased because of the increased diversity

Table I.
Classification of the dishes according to healthy dietary diversity and scores of the respective food groups

Thus, as the value of the positive index increases, the diversity increases, thereby heightening the probability of a healthy meal. On the other hand, as the negative index increases, the number of energy-dense foods on the plate increases.

The cut-off points of the scores of the present study were defined conceptually, considering a minimum healthy dietary diversity criteria and using other studies for reference (Fisberg *et al.*, 2004; Mota *et al.*, 2008). This classification was used adapting the healthy eating index (HEI) for Brazil (Fisberg *et al.*, 2004), where the maximum

score was +12.0. Scores were categorized into three categories: inadequate (≤ 6.0), needs to change (> 6.0 e < 9.0) and healthy (≥ 9.0).

Statistical analyses

Pictures were taken of each plate and analysed individually by the software EpiData 3.1. EpiData was created in 1999 in Denmark, and is used for data entry and data documentation (EpiData Entry) and for basic statistical analysis (Epi data Analysis). It is a free software and is widely used by organizations (e.g. WHO) and individuals to create and analyse large amounts of data (EpiData, 2013). The foods on the plate of each diner were identified and registered according to their number in the spread sheet.

Data were expressed as absolute values and percentages. Pearson's χ^2 test was used to verify the associations between dietary diversity scores (DDS), characteristics of the diners and recommendations of the Brazilian Food Guide.

The DDI-M proposed after the consensus workshop was tested for associations with demographic characteristics of the diners, such as gender, age, education level and marital status.

All statistical analyses were conducted with the use of the software Statistical Software Package for the Social Sciences, version 16.0 (SPSS Inc., Chicago, IL, USA). The significance level was set at 5 per cent ($p < 0.05$).

Results

Description of the participants

Participants of the study were 678 regular diners of the chosen restaurant, aged 16-81 years. The majority of participants were aged 20-59 years (78 per cent), followed by adolescents aged 16-19 years (16.2 per cent) and elderly people aged 60-81 years (5.3 per cent). The majority were females (53.4 per cent) and single (55.3 per cent); 38.4 per cent were married and 6.3 per cent were divorced or widowed. Around 51.0 per cent of consumers had completed high school, 40.5 per cent had completed higher education and 8.5 per cent had not completed high school.

DDS associated with dish/meals

Table II shows the scores of the diners' plates. A significant association ($p = 0.028$) was found between a higher positive diversity score of a plate and a energy-dense foods on it.

Higher DDS were associated with the presence of rice and beans (usually eaten together, $p < 0.001$), fruits and vegetables ($p = 0.000$) or lean meats and fish ($p = 0.000$) on a plate. Lower DDS were associated with the presence of pickles, energy-dense food and fatty meats (Table III). There was no association between the presence of energy-dense foods and rice and beans, suggesting that energy-dense foods were not used to replace rice and beans (data not shown).

Table IV shows associations between presence of energy-dense foods on the plate and healthy DDS. An association was found between lower scores (score ≤ 6) and the presence of mayonnaise, fried polenta (boiled cornmeal), fries, lasagne and pastas. This fact indicates that lower diversity indices are related to energy-dense meals and low dietary diversity.

In the present study, healthy DDS were not statistically associated with socio-demographic data, that is, gender, age, education level and marital status (data not shown).

Discussion

The study has some limitations. First, the pilot study was restricted to a single restaurant. However, as the chosen restaurant was considered to be representative of the other restaurants surveyed, their consumers may also be seen to represent the characteristics of the population of interest, indicating data generalizability. Second, only the food choices of a single meal were analysed, which may not coincide with consumption or dietary habits. However, considering that the food choices were self-selected by the consumers who were familiar with this type of restaurant, the meals analysed are likely to represent their usual intake in such a commercial situation. Considering that there are many dishes to choose from, a diverse meal may indicate that the diner has healthy food habits. Previous studies demonstrate that more dietary variety and/or diversity reflect the potential for a healthier choice and are related to diet quality (Kant *et al.*, 1993; Drewnowski *et al.*, 1997; Dixon *et al.*, 2001; Volp *et al.*, 2010; Azadbakht and Esmailzadeh, 2011). DDS show promise as a rapid and efficient means to estimate nutrient adequacy of the diet. Although the link between increasing diversity of the diet and increased nutrient intake has been made, the relationship

Table II.
Distribution of diners in the healthy dietary diversity categories of a main meal according to plate scores and association between diversity score of a plate and number of energy-dense foods on it

Diners (%)	≤6.0	Positive score > 6.0 e < 9.0	≥9.0	Negative score			
	Inadequate	Needs to change	Healthy	-3.0	-1.5	0	
	65.3	24.5	10.2	45.9	36.9	17.3	
		Number of energy-dense foods*					
Scores	< 6.0	Up to 1			2 or more		
Meals (%)	51.6	> 6.0		< 6.0		> 6.0	
		60.8*		48.4		39.2*	

Note: **p* = 0.028

Recommendations	Diversity scores			<i>p</i>
	0-6 Inadequate	6.5-9 Needs to change	9.5-12 Healthy	
<i>Rice and beans</i>				
No	96.1	3.9	0.0	< 0.001*
Yes	56.5	30.4	13.1	
<i>Fruits and vegetables</i>				
No	92.7	6.0	1.3	0.000*
Yes	57.5	29.8	12.7	
No	72.1	22.7	5.3	0.000*
Yes	30.3	33.9	35.8	
<i>Lean meats</i>				
No	73.7	23.7	2.6	0.000*
Yes	59.7	25.0	15.3	
<i>Energy-dense foods^a</i>				
No	33.3	26.7	40.0	0.000*
Yes	66.1	24.4	9.5	
Total	65.3	24.5	10.2	

Notes: ^aPresence of fried foods, high-fat sauces, sausages, pickles, fruit compotes, sweets and pastries.
**p* < 0.05

Table III.
Association between healthy dietary diversity scores of a main meal and food groups on the plate, according to the recommendations of the Brazilian Food Guide (Brazil Ministry of Health, 2008)

BFJ 117,1	Foods	Diversity scores (positive)			<i>p</i>
		< 6 (%) ^a Inadequate	6 A 9 (%) Needs to change	> 9 (%) Healthy	
294	<i>Potato salad with mayonnaise</i>				
	No	63.4	25.5	11.1	
	Yes	77.4	18.3	4.3	0.021*
	<i>Fried polenta</i>				
	No	64.2	24.8	11.0	
	Yes	77.6	20.7	1.7	0.043*
	<i>Fries</i>				
	No	61.9	26.5	11.6	
	Yes	71.7	20.8	7.5	0.032*
	<i>Shoestring potatoes</i>				
	No	64.0	25.6	10.5	
	Yes	73.7	17.9	8.4	0.176
	<i>Crab balls</i>				
	No	64.5	24.9	10.6	
	Yes	80.6	16.7	2.8	0.114
	<i>Savoury pies</i>				
	No	65.5	24.4	10.1	
	Yes	63.6	25.0	11.4	0.955
	<i>Farofa</i>				
	No	67.0	23.8	9.2	
Yes	58.5	27.4	14.1	0.116	
<i>Lasagne and pastas</i>					
No	62.1	26.0	11.9		
Yes	82.4	16.7	0.9	0.000*	
<i>Pastel</i>					
No	65.3	24.6	10.1		
Yes	65.3	23.6	11.1	0.954	

Table IV. Distribution of the diners' plates according to positive healthy dietary diversity scores and the presence of food whose intake should be controlled, from a nutritional viewpoint

Notes: ^aAssociations between presence of food whose intake should be controlled, from a nutritional viewpoint, on the plate. The smaller healthy dietary diversity scores index < 6.0. **p* < 0.05

between dietary diversity and adequate micronutrient intake has not yet been sufficiently validated across different cultural settings and in different age groups (Steyn *et al.*, 2006). In this sense, the validation of our study is necessary to confirm this hypothesis.

Our index is not intended to encompass the different cooking techniques, although this may be of interest as each chef has their own technique of preparing meals. Additionally, our focus was not on the quantitative caloric value of each dish, but on qualitative observation and assessment. A positive point of the present study is the fact that food choice analysis was based on direct observation of the plates and not on self-reported data. This method of analysing dietary practices is cited as a strategy to improve the reliability of collected data (Poulain and Proença, 2003). Nonetheless, the analysis of actual food intake is considered to ensure greater accuracy (Ngo *et al.*, 2009; Rodrigues *et al.*, 2012). However, it could be argued that photographs are quickly applied and cost-effective, and cause minimal interference with the consumer's mealtime (Swanson, 2008; Rodrigues and Proença, 2011; Hinton *et al.*, 2013).

Most diners (65.3 per cent) obtained a positive score ≤ 6.0 and 45.9 per cent chose one or more foods from subgroup C3, that is, energy-dense foods, which may suggest that

the meal contained excess calories. Azadbakht and Esmailzadeh (2012) revealed significant inverse associations between dietary energy density and the DDS in university students with an average dietary intake. Furthermore, it was found that a high dietary energy density is associated with unhealthy food choices.

Most participants obtained a low healthy DDS (< 6.0), indicating that one or more food groups that should have been present in a main meal were not. Despite the use of different methods, some studies using indexes to assess dietary quality (Kant *et al.*, 1993; Fisberg *et al.*, 2004; Kim *et al.*, 2003; Godoy *et al.*, 2006; Oldewage-Theron and Kruger, 2008; Gorgulho *et al.*, 2011; Louzada *et al.*, 2012) corroborated the findings of the present study, indicating that the diets of adolescents, adults and elderly people from different countries, such as the USA, China, South Africa and Brazil, need improvements such as an increased intake of fruits, vegetables and a reduce intake of sodium, fat, saturated fat, and empty calorie foods.

A study that evaluated the dietary quality of a representative sample of the Belgian population found an inverse association between dietary diversity within the group of energy-dense and nutrient-poor foods, and this corroborates the findings of the present study (Vandevijvere *et al.*, 2010).

The present study found an association between higher healthy DDS and the recommendations of the Brazilian Food Guide (Brazil Ministry of Health, 2008) and the WHO's Global Strategy on Diet, Physical Activity and Health (WHO, 2004). The recent document from World Health Organization (2013) about an action plan for the prevention and control of noncommunicable diseases 2013-2020 confirms these recommendations. Other studies have also constructed indices based on their local food guides (Patterson *et al.*, 1994; Kennedy *et al.*, 1995; Haines *et al.*, 1999; Kant *et al.*, 2000; Kim *et al.*, 2003; Fisberg *et al.*, 2004; Ponce *et al.*, 2006; Drescher *et al.*, 2007; Bandoni and Jaime, 2008; Previdelli *et al.*, 2011). The present study suggest that a greater diversity of foods on the plate may indicate a healthier diet however; further studies are required using indexes to confirm this statement in different contexts.

Wirt and Collins (2009), in a systematic review, presented some studies that constructed a method for assessing diet quality. The method included food groups similar to those of the present study, such as cooked and raw vegetables, whole grains and fish, based on national nutrition recommendations and national dietary guidelines specific to the country where the tool was developed.

In Brazil, the HEI was adapted to the local context, and it was found that high scores obtained by this instrument were associated with dietary variety, high consumption of fruits and low consumption of total and saturated fats (Fisberg *et al.*, 2004). Furthermore, the HEI was adapted and administered to a population of 437 adolescents and found that 68 per cent needed to improve their diets and 28 per cent had inappropriate diets. In other words, 96 per cent of the adolescents presented low consumption of fruits, vegetables, milk and dairy (Godoy *et al.*, 2006). Recently, the HEI was applied to evaluate the dietary quality of pre-school children and to identify maternal and family characteristics associated with this score and its components. The total HEI score in these children indicates that compliance with dietary guidelines is generally poor and that most of the children have diets that need improvement (Rauber *et al.*, 2012). Furthermore, the HEI was revised to allow for the measurement of dietary risk factors for chronic diseases, evaluating and monitoring the diet at both individual and population levels (Previdelli *et al.*, 2011).

The index proposed by the current study also indicated that the consumption of two or more energy-dense foods was associated with a lower healthy DDS

(score ≤ 6.0 , $p = 0.028$). Moreover, some energy-dense dishes, such as fries, fried polenta, pastas, lasagne and potato salad with mayonnaise, were associated with lower DDS. This profile involving the consumption of foods where intake should be controlled, from a nutritional viewpoint, has already been discussed in other studies, which found a relationship between this profile and overweight and obesity (Paeratakul *et al.*, 2003; Kant and Graubard, 2004; Mehta and Chang, 2008; Duffey *et al.*, 2009; Fulkerson *et al.*, 2011; Lachat *et al.*, 2012).

In the present study, healthy DDS were not statistically associated with demographic data. These findings seem to indicate that when people are exposed to a great variety of foods, as seen in self-service buffets, they tend to eat in a similar manner. Some studies have shown that high scores obtained by dietary assessment indices are related to a nutritionally appropriate diet and also with higher socioeconomic levels (Patterson *et al.*, 1994; Haines *et al.*, 1999; Bowman *et al.*, 1998). One study did not find differences between men and women with relation to diet quality, corroborating the present findings (Kant *et al.*, 1993).

Although the studied buffet table offered a great variety of healthy foods, most diners (83 per cent) put at least one energy-dense dish on their plates. Some Brazilian studies found an association between eating away from home and consumption of foods that contain a higher caloric density and more total fats, saturated fats, sugar and sodium, corroborating the present study (Bezerra and Sichieri, 2009). Studies in other countries made a similar finding, that is, that eating out meant consuming a higher number of calories per meal (Lin *et al.*, 1999; Guthrie *et al.*, 2002; Orfanos *et al.*, 2007; Lachat *et al.*, 2012).

A recent assessment of people eating away from home found that Brazilians living in urban areas present a high consumption of fries (33 per cent), farofa[1] (30.1 per cent), pizzas (42.1 per cent) and pastas (18 per cent). Furthermore, as family income increases, so does the likelihood of eating out. The most consumed foods in Brazil are rice (160.3 g/day), beans (182.9 g/day), beef (63.2 g/day) and juices and sodas (Instituto Brasileiro de Geografia e Estatística, 2010).

The present pilot study proposed that a higher positive healthy DDS is associated with the Brazilian Food Guide and WHO recommendations. Moreover, when people are exposed to many different dishes, such as at a buffet table, they seem to eat in a similar fashion, regardless of their socio-demographic characteristics.

Most diners obtained a low healthy diversity score. Higher DDS were associated with the presence of rice and beans, fruits, vegetables, lean meats and fish on the plate. What is more, most diners consumed, in addition to rice and beans, at least one energy-dense dish, indicating that these foods were consumed together with the combination of rice and beans, and not to replace it.

The tool proposed in this study may serve as an aid for defining the food intake characteristics of diners who eat at self-service restaurants. It may help not only to assess this type of consumption but also to structure campaigns promoting healthy food habits. This study also took into account the various methods of food preparation, distinguishing, for example, fried from raw or cooked vegetables, or pickles. This is important when analysing food choices, especially with regard to fat, sugar and sodium intakes.

Finally, the method proposed for assessing the healthy dietary diversity of a main meal can serve as a model for other populations, investigating the quality of the meals consumed away from home and encouraging public policies that stimulate the availability of healthy foods in restaurants. It should be noted that the instrument must

be adapted to the cultural context of other populations, in order to achieve the stated objectives. For example, identify typical preparations and its method of meal preparation or other kinds of restaurants.

Note

1. Farofa: dish of Brazilian kitchen made of manioc flour fried in fat (oil or butter), which can be enriched with other ingredients (sausage, egg, vegetables).

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