Agreement between two Meal Quality Indexes adapted to evaluate food consumption of institutionalized elderly

Concordância entre dois Índices de Qualidade da Refeição adaptados para avaliar o consumo alimentar de idosos institucionalizados

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A B S T R A C T

Objective

To assess agreement between two meal quality indexes adapted for elderly people, evidencing their similarities and differences.

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Methods

Agreement study with 322 institutionalized elderly individuals. Food consumption data were collected by the method of weighted food record, in two nonconsecutive days. The Meal Quality Index and the Main Meal Quality Index of each older adult were calculated for the lunch meal. Agreement between methods was tested by cross-classification in quartiles and weighted *kappa* (Kw), and the difference between medians by the Wilcoxon test.

Results

The Meal Quality Index median was 54.67 points and the Main Meal Quality Index 53.51 points (*p*=0.723). When the components of each index were assessed, those associated to the consumption of carbohydrates, total fat and saturated fat were similar. The consumption of fruits separated from vegetables in the Main Meal Quality Index evidenced low consumption of vegetables by the elderly. Cross-classification by quartiles showed good agreement; the exact one being 48.8% and the disagreement 3.4% (K_w=0,447). The proportion of elderly individuals in the same exact or adjacent quartile was greater than 85.0%. Agreement was higher in males (89.4%, K_w=0.475); in the age range of 70 to 79 years (91.1%; K_w=0.562) and in non-profit nursing homes (96.7%; K_w=0.622).

Conclusion

The two indexes reviewed show a good agreement between them and common characteristics. The number of components is higher in the MMQI and may represent a more detailed assessment of meal quality.

Keywords: Lunch. Elderly. Meal quality. Meals.

R E S U M O

Objetivo

Avaliar a concordância entre dois índices de qualidade da refeição adaptados para idosos, evidenciando suas semelhanças e diferenças.

Métodos

Estudo de concordância realizado com 322 idosos institucionalizados. Os dados de consumo alimentar foram coletados pelo método de registro alimentar por pesagem, em dois dias não consecutivos. Foram calculados o Índice de Qualidade da Refeição e o Main Meal Quality Index de cada idoso para a refeição do almoço. A concordância entre os métodos foi testada pela classificação cruzada em quartis e kappa ponderado (K_p), e a diferença entre medianas pelo teste de Wilcoxon.

Resultados

A mediana do Índice de Qualidade da Refeição foi de 54,67 pontos e do Main Meal Quality Index foi de 53,51 pontos (p=0,723). Quando avaliado os componentes de cada índice, os relacionados ao consumo de carboidratos, gordura total e gordura saturada foram semelhantes. O componente frutas, separado das verduras no Main Meal Quality Index evidenciou o baixo consumo de verduras pelos idosos. A classificação cruzada por quartis mostrou boa concordância, sendo a exata de 48,8% e a discordância de 3,4% (K_p=0,447). A proporção de idosos no mesmo quartil ou quartil adjacente foi de mais de 85,0%. A concordância foi maior no sexo masculino (89,4%; K_p=0,475); na faixa etária de 70 a 79 anos (91,1%; K_p=0,562) e nas instituições sem fins lucrativos (96,7%; K_p=0,622).

Conclusão

Os dois índices analisados tem uma boa concordância entre si e características em comum. O número de componentes é maior no MMQI, podendo representar avaliação mais detalhada da qualidade da refeição.

Palavras-chave: *Almoço. Idoso. Qualidade da refeição. Refeições.*

I N T R O D U C T I O N

Brazilian population has experienced a changing process in age structure due to the decrease in fertility levels and increase in life expectancy, leading to a greater population aging [1,2]. This

demographic transition has led to an increase in the provision of formal care services, among which Long-term Care Institutions for the Elderly (LTCI) [3].

In the city of *Natal, Rio Grande do Norte*, located in the northeastern region of Brazil, institutionalized elderly people are characterized for being, for the most part, non-literate, retired and resident in non-profit institutions, which are associated with worse socioeconomic conditions, reflecting the social inequality in this field [4]. The health profile of these elderly people is marked by high incidence of diseases, cognitive incapacity, depression, functional capacity decline during the institutionalization term and restrictions in daily activities capacity [5-8].

It is important to emphasize that aging is a natural process involving anatomical and functional changes, with repercussions on the health conditions and the nutritional status of the elderly [9]. Additionally, institutionalization imposes changes in the routine of elderly people that can change their dietary habits and influence their health fragility, due to reduced food acceptance and consequent impairment of their nutritional status [10,11].

Healthy food intake is a primary factor in fostering and maintaining healthy conditions throughout life, being one of the main factors capable of conditioning quality of life and longevity [1,12]. Since feeding takes place on food occasions that are composed of different foods with complex nutrient combinations that interact with each other, understanding the nutritional composition of meals and their impact on diet quality is essential [13,14]. In addition, meal patterns represent interactions between food and environment, as well as with genetics, personality, circadian rhythm and social determinants, and are associated with different diseases [15].

The quality of food and of meals can be assessed by means of consumption patterns, by a priori dietary indexes, such as the Meal Quality Index (MQI) [16] and the Main Meal Quality Index (MMQI) [17]. However, there is a lack of dietary indexes to evaluate the meal quality of the elderly, especially of those institutionalized, since no index applied to this target audience has been found in the literature to date [18,19].

The MQI was proposed to review the quality of the meals offered to workers by the *Programa de Alimentação do Trabalhador* (PAT, Workers' Food Program), and its use is interesting to assess collectivities, while the MMQI proposes an assessment of the quality of the main meal in different frameworks and populations [16,17]. Thus, the present study aims at reviewing the agreement between the two above mentioned meal quality indexes, highlighting their similarities and differences.

METHODS

This is a concordance rate study nested in a cross-sectional, population-based, census-based study at Long-Term Care Institutions for The Elderly (LTCI) in the city of *Natal* (RN), Brazil. The study population includes all residents aged 60 years and older who were not on exclusive enteral nutrition. Out of the 415 residents in the city's 14 LTCI during the period 2013 - 2014, five were not elderly (less than 60 years), 13 were enteral-supported, and 75 did not agree to participate in the survey, totaling 322 eligible older people in 10 LTCI.

This study is linked to the "Human Aging and Health Project: The Reality of the Institutionalized Elderly People in *Natal* Municipality, RN", approved by the Research Ethics Committee (Central Committee) of the Federal University of *Rio Grande do Norte*, with Presentation Certificate for Ethical Appraisal (CAAE) number 0290.0.051.000-11, approved according to Opinion No. 308/2012.

Food consumption data were collected by a previously trained technical team using the Dietary Record (DR) method of direct food weighing, in two nonconsecutive days. Food consumption was recorded through standardized portions counting.

By direct observation, it was checked whether the elderly repeated, switched food with other older persons, consumed some other food that was not on the menu, refused the preparations or left some food in their plate. The amount of food consumed (in grams) was determined by the difference between the quantity offered and the left over.

Afterwards, a standardization of the foods consumed was carried out to make the different modes of preparation and commercial brands uniform, thus minimizing errors in the review of the dietary intake.

Analysis of food consumption data

For the review of the Preparation Technical Sheets, a hybrid food composition table was generated in Excel® (Microsoft, Office Package, version 2013), using the nutrient information available in the Brazilian Table of Food Composition – TACO [20] supplemented with data of the nutrients folate, selenium, vitamin B12, vitamin D and vitamin E obtained from the United States Department of Agriculture (USDA, Release 27) [21], which are not available in the Brazilian table.

Subsequently, food was analyzed in the virtual environment of the Virtual Nutri Plus® software and a spreadsheet of the final consumption of each elderly individual was prepared, containing the standardized foods, the final amount consumed and their chemical composition.

Quality of the meal

The quality of the meal was assessed by the Meal Quality Index [16] and the Main Meal Quality Index [17], which were chosen because they have been developed for and applied to the Brazilian population [16,22] Chart 1. In addition, it was decided to analyze the lunch meal since it represents the main meal in Brazil [22,23] and, in order to allow comparisons, it was the meal analyzed in both indexes.

Such indexes were adapted to the elderly in terms of carbohydrates, total fat and saturated fat components consumption following the recommendations of the Brazilian Dyslipidemia and Prevention of Atherosclerosis Guideline – 2017. Changes involved: the carbohydrates component that was expected to supply 55 to 75% of the total calories intake and turned then to be reduced to a consumption of 50 to 60% as being appropriate; the total fat component increased from 15-30% to 25-35% and the saturated fat component decreased from 10-13% to 7-10% [24]. In addition, the MQI was adapted to assess the foods consumed, since this method originally assesses the foods offered.

Scores were distributed proportionally between the minimum and maximum values, so that the highest score represents the closest to the appropriate component's value, according to the formula described below. The maximum total value of the two indexes is 100 points.

$$Y = \frac{P * (X - V_{min})}{(V_{max} - V_{min})}$$

Y: Score to be determined

P: Maximum component score

X: Consumed amount

V_{max}: Value of the component that equals the maximum score

V_{min}: Value of the component that equals 0 Score

Chart 1. Components of the Meal Quality Index (MQI) and of the Main Meal Quality Index (MMQI).

Indicator	Scores	
	Minimum	Maximum
MQI[a]		
Fruits and vegetables consumption	Consumption ≤80g with score 0.	Consumption ≥160g with score 20.
Carbohydrates consumption[c]	Consumption ≤40% or ≥75% with score 0.	Consumption between 50% and 60% with score 20.
Total fat consumption[c]	Consumption ≥40% or ≤15% with score 0.	Consumption between 25% and 30% with score 20.
Saturated fat consumption[c]	Consumption ≥10% with score 0.	Consumption ≤7% with score 20.
Meal variability	Meal with less than 4 food and 2 groups with score 0.	Meal with at least 11 different food and 5 different groups received score 20.
MMQI[b]		
Fruits consumption	Consumption de 0g with score 0.	Consumption ≥80g with score 10.
Vegetables consumption	Consumption ≤80g with score 0.	Consumption ≥160g with score 10.
Animal protein/total protein	Ratio between animal protein and total protein consumption = 100% with score 0.	≤80% with score 10.
Fiber	Consumption ≤7g with score 0.	Consumption ≥10g with score 10.
Carbohydrates consumption[c]	Consumption ≤40% or ≥75% with score 0.	Consumption between 50% and 60% with score 10.
Total fat consumption[c]	Consumption ≥40% or ≤15% with score 0.	Consumption between 25% and 30% calories with score 10.
Saturated fat consumption[c]	Consumption ≥10% with score 0.	Consumption ≤7% with score 10.
Processed meat	Consumption of 1 or more portions with score 0.	No intake with score 10.
Desserts and sweetened drinks	Consumption of 1 or more portion with score 0.	No intake with score 10.
Energy Density	Meal energy density ≥1,65kcal/g with score 0.	Meal energy density ≤1,25kcal/g with score 10.

Note: [a]Bandoni & Jaime [16]; [b]Gorgulho *et al*. [19]; [c]Recommendations of carbohydrates, total fat and saturated fat consumption were modified for the age group of the elderly population (≥60 years) (Faludi *et al*. [24]).

Statistical analysis

First, variables normality was verified using the *Kolmogorov-Sminorv* test, which indicates that the data referring to the two indexes assessed did not exhibit a normal distribution. To assess the statistical significance of all the tests, the value of $p<0.05$ was considered.

The study population was characterized according to gender, age, and type of LTCI by absolute and percentage frequencies. Quartiles were calculated for each index and were plotted in boxplot charts. To assess agreement between the two meal quality indexes, the Wilcoxon test was used, considering differences to be significant when $p<0.05$.

The medians of all the components of the indexes were calculated, in order to assess similarities and differences of each index components. In addition, the percent frequencies were calculated to demonstrate the relative contribution of each component to the final score.

The scores of each elderly individual were classified in the intervals between the quartiles calculated for each of the quality indexes of the meal (1st Interval – 0 to P25, 2nd Interval – P25 to

P50, 3rd Interval – P50 to P75; 4th Interval – P75 to P100). Agreement between the two methods was tested by cross-classification of such classification between the two indexes and the weighted *kappa* was calculated. The *kappa* classification criteria used were those of Landis and Koch [25]. In addition, the proportion of elderly persons classified in the same consumption quartile in the two methods (exact agreement), in the same quartile and in the adjacent quartiles (exact + adjacent agreement) and opposite quartiles (disagreement) were assessed.

RSULTS

The population analyzed was predominantly female (74.0%) and the majority resided in non-profit institutions (66.5%). Regarding age, more than half (58.5%) were over 80 years old, 29.0% were between 70 and 79 years old, and 12.5% were between 60 and 69 years old (data not shown in the Table).

The median MQI was 54.67 points and the MMQI was 53.51 points. There were no statistically significant differences between the two indexes (*p*=0.723). However, it should be pointed out that the MQI exhibited greater data dispersion than the MMQI (Figure 1).
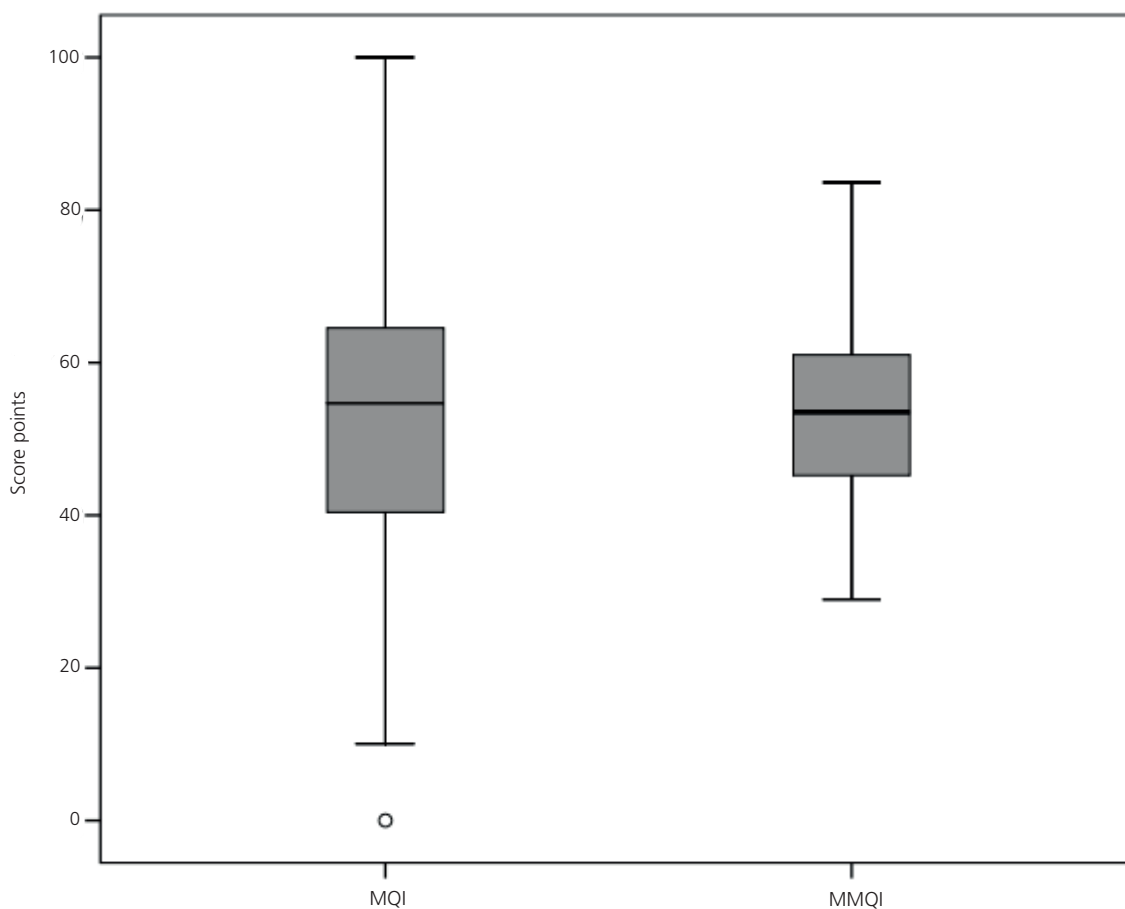

Figure 1. Score comparison of two meal quality indexes among institutionalized elderly. *Natal* (RN), 2013.

Note: MQI: Meal Quality Index; MMQI: Main Meal Quality Index.

MQI and MMQI and their corresponding components are detailed in Table 1. Carbohydrate, total fat and saturated fat components were proportionally similar considering that the MQI score was practically the double of the MMQI, a difference derived solely by the scales of values used in the indexes – in the MQI each component varies from 0 to 20, while in the MMQI it varies from 0 to 10. Thus, the scores of each component have a greater relative contribution to the total score in the MQI than in the MMQI, considering that the MQI exhibits fewer components. It is noteworthy that when showing fruit consumption separated from vegetables in the MMQI, a low consumption of vegetables was evidenced in the elderly. In addition, the components contained in the MMQI allowed to observe other aspects of the elderly diet quality: higher median scores for the components "Desserts and sweetened drinks", "Processed meats" and "Animal / total protein *ratio*", indicated a good quality for these items and lower scores for "Energy Density". It should be noted that the

Table 1. Median score and relative percentage of total components of the Meal Quality Index (MQI) and of the Main Meal Quality Index (MMQI). *Natal* (RN), 2013.

MQI	Score	% of total	MMQI	Score	% of total
Carbohydrates	8.26	14.93	Carbohydrates	4.13	7.85
Total fat	10.00	18.07	Total fat	5.00	9.51
Saturated fat	14.67	26.51	Saturated fat	7.34	13.96
Fruits, vegetables, greens	10.50	18.98	Fruits	5.00	9.51
			Vegetables	0.00	0.00
Meal variability	11.90	21.51	Desserts and sweetened drinks	10.00	19.01
			Processed meats	10.00	19.01
			Fiber	1.40	2.66
			Animal protein / total	9.72	18.49
			Energy density	0.00	0.00
Total	55.33	100.00	Total	52.59	100.00

Table 2. Cross-classification of the Meal Quality Index (MQI) vs. Main Meal Quality Index (MMQI) according to gender, age group and type of Long Term Care Institutions for the Elderly (LTCI). *Natal* (RN), 2013.

Variables/Categories	Weighted *Kappa*	Exact agreement[a]		Exact agreement + adjacent[b]		Disagreement[c]	
		n	%	n	%	n	%
Gender							
Male	0.475	39	46.5	75	89.4	2	2.4
Female	0.437	118	49.6	201	84.5	9	3.8
Age Group							
60-69 years	0.452	17	43.5	35	89.7	1	2.6
70-79 years	0.562	52	57.8	82	91.1	1	1.1
80 years or +	0.371	82	44.9	150	82.0	9	4.9
LTCI type							
Non-profit	0.622	122	57.0	207	96.7	0	0.0
For-profit	0.074	35	32.5	69	63.9	11	10.2
Total	0.447	157	48.8	276	85.7	11	3.4

Note: [a]Classification in the same quartile; [b]Classification in the same quartile and in adjacent quartiles; [c]Classification in opposing quartiles. LTCI: Long Term Care Institutions for the Elderly.

component that contributed most in the total score was saturated fat in the MQI, and desserts and sweetened beverages and processed meats in the MMQI.

The cross-classification of the two indexes according to gender, age group and type of LTCI is shown in Table 2. In general, most of the individuals exhibited good agreement between the two indexes, being classified in the same quartile or in the adjacent one (85.7%). Disagreement between methods was low (3.4%). Agreement was higher in males (89.4%, weighted *kappa* = 0.475); in the age group of 70 to 79 years (91.1%; weighted *kappa* = 0.562) and in the non-profit LTCIs (96.7%; weighted *kappa* = 0.622).

DISCUSSION

This pioneer study assessed the agreement between two dietary indexes of meal quality evaluation in elderly people living in LTCIs of a capital city in Northeast Brazil. Agreement between the instruments was tested with different approaches. Initially, individuals' classification into quartiles was performed in order to show the degree of agreement between the methods. High agreement was observed, with more than 85% of the individuals classified in the same or adjacent quartiles.

According to the *Kappa* classification proposed by Landis and Koch [25], the observed agreements were moderate for total classification, male gender, non-profit institutions and age group between 70 and 80 years (*kappa* between 0.41 and 0.60) and regular for the female gender and age groups between 60 and 70 years and over 80 years of age (*kappa* between 0.21 and 0.40), and weak agreement was verified only in the case of for-profit institutions. The weighted *kappa* values showed reasonable agreement between the methods. These results are consistent with the literature data when it comes to food consumption [26-28].

It is important to note that, likewise, when used in validation and reproducibility studies of food survey instruments, participants' classification according to the quartile distribution can both group individuals with different levels of meal quality into the same category, as well as put into different categories those with similar levels, if they are very close to the cut-off point [29]. Since the sample size used was within the range recommended for validation studies, there is a relative reduction of this bias [30].

Thus, the two indexes evaluated showed good agreement between them, indicating that the use of either indexes would produce very similar results regarding the assessment of meal quality, considering the scores. However, it is necessary to consider the applicability of each index, as well as qualitatively assess the best to be used in each situation.

MQI has fewer components, which may restrict a more detailed analysis of the meal. Therefore, each component of the MQI has a higher relative contribution to the overall score, so that few items with high scores may excessively increase the final score. For example, when it comes to the quality of the elderlies' meal, adequate macronutrient consumption scores may mask the result of low fruit and vegetable intake or food monotony.

Regarding the information generated, both indexes review items that are relevant to the current health context, such as total and saturated fat and carbohydrates consumption. MQI allows assessing the condition of food monotony through the item Variability. However, it has the limitation that this component classifies as adequate a meal with many foods and food groups, leading to questioning if the amount proposed would be adequate to be ingested in only one meal.

Another point assessed was the applicability of the index in the different phases of life. The MQI, because it was developed for corporate workers, can be adapted to other types of collectivities. However, it is difficult to use it in other population groups due to its specificity.

Originally the MQI method assessed the meal offered, which may be different from the meal consumed. The proposal being an assessment of collective feeding, like the PAT, can contribute to the assessment of the effectiveness of food and nutrition policies for workers. In the case of the institutionalized elderly, supply may be close to consumption, which would not imply in an important analysis difference from the point of view of food consumption.

In relation to the MMQI, the MQI includes more components, allowing a more detailed assessment of a meal features and has a smaller relative contribution of each component to the total.

The MMQI does not have a specific component to discuss food variability; however, the components included in this index may contribute to the review of food monotony. The MMQI analyzes important items such as excessive consumption of animal protein, besides positively evaluating minimally processed foods and related nutrients (fruits, vegetables, fiber) and negatively the consumption of food and nutrients harmful to health (processed meat, saturated fat, desserts and sweetened drinks).

About the applicability in life stages, although developed for the adult population, the MMQI comprises important components for all age groups and population groups.

Regarding macronutrients, both indexes assessed the consumption of carbohydrates, total fat and saturated fat. Analysis of these macronutrients is of basic importance for elderly people's health, considering that, when in excess, they are associated with the occurrence of diabetes, arterial hypertension, obesity, cardiovascular diseases, among others. However, only MMQI has a component related to protein quality, which is an essential macronutrient in the diet of the elderly, since low amounts of animal protein in the diet are associated with sarcopenia, muscular loss, malnutrition, fragility, falls and dependency in older people [31,32].

In the MQI's component of fruits and vegetables, it was observed that, because it was aggregated, it was not evident that, out of the main dietary fiber sources, the population assessed consumed only fruits, and not the three types of food, as recommended by the Food Guide for the Brazilian population [33]. In the MMQI, this analysis is possible because the components "fruits" and "vegetables" are separated, being this another positive point of such index.

Another advantage of the MMQI is that it presents components related to the risk of cardiometabolic diseases development, such as ultra processed foods (processed meat and stuffed food), sweets and sweetened beverages [22,23,32].

In addition, the MMQI assesses the energy density of meals consumed by the elderly. Studies indicate that collective meals geared to ill or hospitalized individuals, energy density can be used for obesity and chronic diseases treatment, helping in the nutritional status recovery and in the process of weight gain, since malnutrition is common in hospitalized patients, as well as in the institutionalized elderly [3, 34]. Foods with high energy density like potatoes, biscuits and meat products have a high fat or sugar content, while foods with reduced energy density have more water in their composition, such as fruits, vegetables and soups. Thus, energy density is also associated with diet quality [35,36].

The authors acknowledge that the assessment of food consumption may present measurement errors due to the nature of this type of information. However, the study has as strong points

the method of collecting food consumption data from food records by weighing, which already eliminates a few biases that impair indirect methods. In addition, the survey was carried out in 10 out of 14 Long-term Residency Institutions in the municipality, representing 77.6% of the population at the time of data collection, which allowed an overview of the institutionalized older people in the municipality and enhancing the pioneering nature of the study, because there is no other study comparing meal indexes.

The search for food standards classification through indexes is continuous, since feeding is a multidimensional phenomenon [37]. These indexes allow the simultaneous assessment of food and nutrient intake, allowing an indirect analysis of meal components without a reduction to a single item [16].

The limited knowledge of the food situation of the elderly in Brazil considering the new demographic reality requires further investigation [38]. Studies of this nature about nutritional quality of meals for the elderly, especially the institutionalized ones, have not been published to-date, thus highlighting the relevance of this study.

CONCLUSION

The findings of this study indicate that the two meal quality indexes reviewed have a good agreement between them, so that the use of any of the two would result in similar review outcomes, considering the scores. However, the MMQI exhibits a more detailed assessment of the meal quality because it includes a greater number and combination of components, allowing the assessment of both risk and protection factors for the development of chronic non-communicable diseases.

CONTRIBUTORS

RG Germoglio contributed with the conception, design, review and interpretation of the data, article writing and critical review of the intellectual content. LCP Liberalino and NLA Cabral contributed with the critical review of the intellectual content. KC Lima, SCVC Lima and CO Lyra contributed with data analysis and interpretation, article writing and critical review of the intellectual content. All the authors evaluated and approved the final version to be published.

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