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# Reproducibility study of the meal quality index

# Estudio de reproductibilidad del índice de calidad de comida

ABSTRACT

*Objective: The aims of this study were to replicate the Meals Quality Index (MQI) and to analyze the reproducibility of two indices (MQI-5 and MQI-10) to measure the quality of meals offered at a University Restaurant. Method: The food supply was assessed by direct observation of the portioning of preparations distributed to students. Meal quality was determined using two MQI procedures, MQI-5 and MQI-10. It was decided by Cronbach alpha to check the internal consistency and reliability of MQI for university students. Results: The Cronbach alpha results were 0.41872 and 0.4427, respectively for ten and five components. Comparing the amounts of nutritional components in the MQI (10 and 5 components), it was found that carbohydrate was higher for MQI-10 and total fat and saturated fat for MQI-5. Conclusion: The Cronbach alpha value cannot to be credited in this study of replication due to the small sample size. Regarding reproducibility, when the total score between methods (MQI-5 and MQI-10) was compared, no similarity between results was found, although methodologies were applied to individuals in the same group (university students).*
*Key words: feeding, students, food services.*

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## INTRODUCTION

The relationship between diet and health can be assessment by the amount of nutrients in food, and food group patterns (1). Several studies have shown the importance of adequate feeding in the prevention of nutritional deficiencies and noncommunicable chronic diseases (2-3). It has been shown the importance of assessing the quality of meals made outside home (4). In Brazil, it is estimated that among five meals, one is made outside home. These numbers indicate that there would be a great increase and development of fast food businesses due to increasing urbanization, increased participation of women in the job market, socioeconomic and cultural differences and changes in the familiar arrangement (5).

In this context, the quality of diet in groups of interest should be assessed, particularly in food service, so as to identify potential nutritional deficiencies and subsequently to implement educational actions (6).

Several indexes have been proposed to assess the quality of diets and guide the individual dietary intake of populations and thus promote health through nutrition education programs aimed at the prevent diseases (6). These indexes consist of a dietary assessment instrument that determines the quality of diets by one or more nutritional parameters (7).

In 2006, the Meals Quality Index (MQI) (8) was developed based on the Revised Diet Quality Index (IQD-R) (9), from Healthy Food Index (10) and in the Food and Healthy Eating Index Adjusted for Brazilian Population (11). The MQI is a simple and reliable measure to assess the quality of the meals to workers. The MQI was initially determined with ten components, but after statistical analysis, it was reduced to five components that received a score ranging from zero to 20 points each, namely: adequate supply of vegetables and fruits, carbohydrates, total fat, saturated fat, and menu variety (8).

Considering that an adequate meal can contribute to better academic performance of students and to the promotion of healthy feeding, it is necessary to evaluate the nutritional quality of meals offered to students in the Food and Nutrition Units of universities. Therefore, it is necessary to use an index to evaluate the overall quality of meals. The aims of this study were two: the first was to replicate the Meals Quality Index MQI and the second was to analyze the reproducibility of two indices (MQI-5) and (MQI-10) to measure the quality of meals, both applied in a university restaurant in Brazil - Rio de Janeiro.

## SUBJECTS AND METHODS

This is a cross-sectional study conducted with university

students aged 20 years and older attending three or more times per week the university restaurant.

It is part of the project named "Nutritional profile and adequacy of nutrients in the meal served to users of Food and Nutrition Units", whose sample was determined according to data model considering malnutrition prevalence of 1.4% and 3.1% for men and women, respectively, and analogously for obesity of 13% and 17.5% (12), with confidence level of 95% and precision of 5%, considering infinite population (13). The accidental sample (14) consisted of at least 138 students invited to participate in the study in the waiting queue for entry into the university restaurant after signing the consent term.

Analysis of the food supply

The meal service at the university includes main dish, garnish, side dish (rice and beans), dessert and fruit juice. The meals were supplied by employees of the Food and Nutrition Unit. The food supply was evaluated by direct observation of the lunch meal. Each participant student received identification that his meal was being observed by own researcher. The researcher took notes of all served preparations to students and also of the number of times that the portions were placed in the dish according to the serving utensils, previously measured and standardized.

The measure standardization was made by weighing three times each dish, with two different measures: full and shallow and then the average weight was calculated before the restaurant was open to the public. It was regarded as appropriate measure when the variability (variation coefficient) was equal to or less than 60% (15). The weight of food was determined by digital scale, Plena brand, with maximum capacity of 2 kg and precision of 0.01 kg. To calculate the nutritional value of meals, the Brazilian Table of Food Composition16 was used. Then, the overall quality of meals was determined by the Meal Quality Index (MQI) proposed by Bandoni (2006) (8). Components are described below:

1- *Offer of fruits and vegetables: verified by the adequacy of the amounts in grams per meal. An offer of 160 g or more received a score of 10; amounts equal and less than 80 g received a score of 0 and intermediate values were proportionately scored.*

2- *Offer of proteins: considered as the percentage in relation to energy, considering an ideal level of 23% or more of total calories, which received score 10. Offer lower than 15% received score 0 and intermediate values were proportionately scored.*

3- *Offer of carbohydrates considered as the percentage in relation to energy, considering ideal level between 55% and 75% of total calories, which received score 10. Offer lower than 40% received score 0 and intermediate values were proportionately scored.*

4- *Offer of fat: considered as the percentage in relation to energy, considering ideal level between 15% and 30% of total calories, which received score 10 and 40% higher of total calories received a score of 0 and intermediate values were proportionately scored.*

5- *Offer of saturated fat considered as the percentage relative to energy supply considering the total energy from saturated fatty acids less than 10%, which received score 10 and offer higher than 13% received score 0 and intermediate values were proportionately scored.*

6- *Offer of polyunsaturated fat considered as the percentage in relation to energy considering the total energy from polyunsaturated fatty acids greater than 6%, which re-*

ceived score 10 and offer lower than 2% received score 0 and intermediate values were proportionately scored.

7- *Offer of cholesterol: offer below 120 mg received scores lower than 10 and greater than 200 mg received score 0 and intermediate values were proportionately scored.*

8- *Offer of sugars: considered as the percentage relative to total energy supply from sugars, values lower than 10% received score 10; greater than 20% received score 0 and intermediate values were proportionately scored.*

9- *Offer of sodium: values less than 800 mg received score 10 and higher than 970 mg received score 0 and intermediate values were proportionately scored.*

10- *Meal variation: it is an indicator that considers the number of food and the number of food groups, adding the scores obtained in these two indicators. Thus, the meal that provided at least 11 different foods and 5 different food groups received score 10, while meal that offered less than 2 food groups and 4 foods received score 0. To determine the number of food groups present in each meal, foods that corresponded to at least half serving of each food group were considered, excluding sugar and sweets, oils and fat, and miscellaneous (coffee, tea, salt, among others), which did not participate in this component.*

The MQI-5 components included only items 1,3,4,5 and 10 and above. MQI was classified according to Bowman et al. (1998) (17), which considers adequate meal that obtaining score greater than 80; meal that needs improvement received score between 51 and 80 and inadequate meal had score less than or equal to 50.

The Cronbach alpha was selected to verify internal consistency and reliability of the IQR for college students. Cronbach alpha results ranging from 0 to 1 indicate the quality of meals. However, there is no cutoff point to consider a Cronbach alpha to evaluate the consistency of the meal quality index (MQI). So, we decided to use the impact of removal of components according to this index. When the removal of a component led to alpha greater than 0.01, should take into account an improvement of instrument18. According to Pasquali (2009) (19), Cronbach alpha greater than 0.70 can be indicative of instrument reliability.

Adherence to the IQR classification considering the two proposals was evaluated by Mc Nemar chi-square test (test for independent sample), it was necessary to group "needs improvement" and "inappropriate" classes as inadequate meal.

This project was approved by the Ethics Committee of "Antonio Pedro" University Hospital of the School of Medicine under number 0090.0.258.000-11 and all participants signed the consent term (20).

RESULTS

Participants were 154 students (sample relative error = 3.8%) all above 20 years of age, who make their meals at least three times a week at the university restaurant, being 67.5% female and 32.5% male. This sample represents about 20% of the universe people. Table 1 shows the impact of the removal of MQI components of students of this restaurant according to Cronbach coefficient.

It was possible to verify that the supply of vegetables and fruits and the meal variety cannot be removed because it led to a decrease in the Cronbach alpha value when compared to the total components (0.41872). The removal of other components showed no impact on the Cronbach alpha value, in which only the cholesterol component showed increased greater than 0.01 (0.3300). The Cronbach alpha value was calculated for the five

components proposed by Bandoni (2006)[8] by showing value increased, that is, 0.4427. However, this finding did not reach reliability of 0.70, which would indicate instrument reliability.

Table 2 shows that the proposal ten components classifies a large number of subjects with inadequate meal than those of five components. However, the Mc Nemar chi-square test (51.98,1, p-value<0,0001) reveals a significant difference.

Table 3 shows the MQI profile with five components for the meals offered to students. It was found that the component supply of vegetables and fruits showed highly significant variability in relation to others, i.e., some students refused the consumption of these foods while others achieved the maximum score. This component reached an average score of 10. Besides this component, the offer of carbohydrate and the meal variability call attention, which had scores below (20).

## DISCUSSION

Food and Nutrition Units (UFN) have as their primary objective to provide adequate food according to the nutritional needs of their customers through balanced menus that meet the energy and nutrient requirements of the population 21. University restaurants aim to provide healthy and inexpensive nutrition, contributing to maintaining the health of students. Fausto et al (2001) (22) found excess protein and energy in a university restaurant meals of São Paulo, suggesting the need

for adjustments in the composition of meals in order to make it suitable to the profile of its customers.

Unlike the studies that analyze the macro and micronu-trients of menus, in this study we decided to use an index to evaluate the quality of the meal offered to students of university restaurants.

Unlike studies that analyze macro and micronutrients of menus, this study used an index to evaluate the quality of meals offered to students at university restaurants.

The option for using the MQI-5 components was based on the impact of the removal of components on the Cronbach alpha value, which showed the impossibility for removing the components corresponding to fruits and vegetables and the variety components of the menu, both cited in the MQI-5 components, proposed by Bandoni (2006) (8). The Mc Nemar Chi-square test revealed no statistically significant difference between proposals with 5 and 10 components. However, it is possible to believe that the The first allows reducing the calculations to assess the quality of the university meal. Then it became a more "friendly tool" to assess the quality of meal.

The results of the Conbrach alpha index were 0.41872 and 0.4427, respectively for ten and five components. Although food consumption studies (23,24,25) point Conbrach alpha index above 0.70, consistent with the cutoff suggested by Pasquali (2009) (19), this study had lower Cronbach alpha,

TABLE 1

Impact of removal of components IQR students of a university restaurant according to the Conbrach coefficient.

| Components | Conbrach Alfa | Impact |
|---|---|---|
| Total - 10 Components | 0.41872 | |
| Removal of component | | |
| Offer of Fruits and vegetable | 0.27164 | 0.147 |
| Offer of Proteins | 0.42504 | \|0.006\| |
| Offer of Carbohydrates | 0.42857 | \|0.010\| |
| Offer of Total fat | 0.42504 | \|0.006\| |
| Offer of Saturated fat | 0.42504 | \|0.006\| |
| Offer of Polyunsaturated fat | 0.42504 | \|0.006\| |
| Offer of Cholesterol | 0.45194 | \|0.033\| |
| Offer of Sodium | 0.43178 | \|0.013\| |
| Offer of Sugars | 0.417670 | \|0.001\| |
| Meal Variation | 0.22165 | \|0.197\| |

n=154

TABLE 2

Classification of the quality of meals offered to students at a university restaurant according to the two proposals using ten and five components.

| MQI | Classification | |
|---|---|---|
| | Adequate (MQI >80) | Inadequate (MQI <80) |
| 10 components | 38 | 116 |
| 5 components | 102 | 52 |

n=154

although not so different from that found in the study of Bandoni (2006) (8). One possible reason for this may be attributable to the smaller sample size of this study (n= 154).

Similarly, Bandoni (2006) (8) found Conbrach alpha values of 0.5173 and 0.6623. This is another reason to choose the proposal of five components (table 1).

The average value of the five-components MQI for the meals analyzed was 81.5 (table 3). Bandoni & Jayme (2008) (22) and Gorgulho et al (2011) (27) analyzed the five-components MQI in the meal of workers and found average values of 66.2 and 64.6 respectively. The best result achieved in the meal offered to university students can be related to the type of service with meals and menus aimed at promoting healthier feed. Although there are guidelines for the feeding of workers (24), the results of studies seem to indicate that the meals offered in companies do not follow these standards.

Bandoni & Jayme (2008) (26) evaluated the meal provided to employees of 72 companies in the city of São Paulo. Comparing the results with those of the present study, there was similarity in relation to supply of fruits and vegetables (score 10.1) and differences in relation to the supply of carbohydrates (score 13.4), total fats (14.2 score) and saturated fats (score 16.3). The justification for this can be attributed to menus offered to university students. Students avoid fried foods and preferred desserts are usually fruits. The MQI values of companies were low due to the higher frequency of fried in menus and sweet desserts, even when fruits are offered simultaneously.

The results of this study showed worse components than of the university meal that is: score 10.3 (offer of fruits and vegetables), score 17.0 (offer of carbohydrate), score 20 (offer of total fat), score 20 (offer of saturated fat), score 14.0 (component variety). According to the results obtained, the authors suggest that one should not take into consideration only the sensory acceptance, but the impact on the user's health and therefore, reduce the offer of fried food, as well as preparations containing added sugar. These recommendations are an important step in the development of menus to be used in university restaurants. This issue seeks an interaction between acceptability and compliance with nutritional requirements and adoption of healthy eating guidelines proposed by the World Health Organization (28).

According to Machado & Simões (2008) (29), the construction of indexes to assess the quality of diets and meals and for monitoring and evaluating the effects of short- and long-term feeding on the population's health is essential. The guidelines recommended by the WHO Global Strategy

in combination with MQI have allowed classifying healthier meals (28).

Finally, the result of the MQI classification suggests that managers of university restaurants should have a commitment with those students (31.8%), which meals reached MQI between 51 e 80 score, which indicates, "needs improvement". However, Bandoni & Jaime (2008)26 found results far more critical among beneficiaries of the Workers' Food Program (WFP), designed to achieve the nutritional requirements of users of Food and Nutrition Units. The results showed 20.8%, 52.7%, 26.5% of users with inadequate meal, meal that needs improvement and adequate meal, respectively.

## CONCLUSION

In this study conducted at a Food and Nutrition Unit, which profile presented self-management of service and technical supervision of nutritionist, it was not possible to achieve a reliability coefficient (Conbrach alpha) according to values suggested in literature.

The MQI-5 showed that the Cronbach alpha value reached 0.4427, far from recommended values (close to 0.70), but not so far from those obtained in the study of Bandoni (0.6623). This Cronbach alpha value cannot be disregarded in this replicability study, despite the small sample size.

Regarding reproducibility, when the total score between methods (MQI-5 and MQI-10 components) was compared, no similarity between results was found, although methodologies were applied to individuals in the same group (university students).

It could not be inferred that the Meals Quality Index (MQI) is a method able to monitor the quality of meals in university restaurants due to a low reliability found in this study. Thus, it could be an instrument that approximates the assumptions of a healthy diet, both for planning and for the evaluation of collective meals, if it was validated in a larger sample.

## RESUMEN

Objetivos: Replicar el Índice de Calidad de las comidas (IQC) y analizar la reproducibilidad de dos IQC, es decir, los componentes IQC-10 y IQC-5, ambos para medir la calidad de la comida ofrecida en una cafetería universitaria. Método: El suministro de alimentos se evaluó mediante la observación directa de la división en porciones de preparaciones distribuidas a los estudiantes. La calidad de la comida se determinó a través de dos procedimientos los componentes IQC-10 y IQC-5. El alfa de Cronbach fue elegido para comprobar la con-

Table 3

Evaluation of the quality of meals offered to students at a university restaurant in Niterói - Rio de Janeiro.

| MQI Components | Average | Standard deviation | Variation coefficient | Minimum and maximum |
|---|---|---|---|---|
| Offer of fruits and vegetable | 10.3 | 6.67 | 65.1 | 0-20 |
| Offer of carbohydrates | 17.0 | 5.09 | 29.74 | 0-20 |
| Offer of total fat | 20.0 | 0 | 0 | 20-20 |
| Offer of saturated fat | 20.0 | 0 | 0 | 20-20 |
| Meal variation | 14.0 | 2.59 | 34.2 | 0-20 |
| MQI (Total) | 81.3 | 11.94 | 36.4 | |

n=154

sistencia interna y la fiabilidad de la IQC para los estudiantes universitarios. Resultados: Los resultados de alfa Cronbach fueron 0,41872 y 0,4427, respectivamente, para IQC-10 y IQC-5 componentes. Al comparar las cantidades nutricionales de la IQC (10 y 5 componentes), se encontró que los hidratos de carbono fueron mayores para el IQC-10 y la grasa y la grasa saturada en el IQC-5. Conclusión: El valor de alfa de Cronbach no puede ser acreditado en este estudio para la replicación, debido al modesto tamaño de la muestra modesto. En cuanto a la reproducibilidad, cuando la puntuación total se comparó entre los dos métodos (IQC-5 y IQC-10), no se encontró una similitud en los resultados, a pesar de las metodologías se aplicaron a los individuos de un mismo grupo (estudiantes universitarios). Palabras clave: comida, estudiantes, servicios de alimentos.

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