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VALIDATION OF A FOOD FREQUENCY QUESTIONNAIRE FOR INDIVIDUALS UNDERGOING COLORECTAL CANCER SCREENING

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ABSTRACT

The objective of this study was to validate the Food Frequency Questionnaire (FFQ) for the adult and elderly population in colorectal cancer screening in the Legal Amazon region. The FFQ and two 24-hour recalls were applied, and nutrient intake estimates were compared. For this, the paired t test, Pearson correlation and Bland-Altman regression were used with a significance level of 5%. Significant correlations were accepted, with R values between 0.4 and 0.7 for macronutrients and 0.3 to 0.7 for micronutrients. For energy, carbohydrates, total and insoluble fiber, lipids, omega-3, monounsaturated, polyunsaturated, saturated fat, calcium, iron, zinc, retinol, cholecalciferol and ascorbic acid, a positive correlation was observed between the methods, being considered acceptable in the analysis of validation. Only for soluble fiber, selenium, and proteins the R values obtained were lower than 0.30. Bland-Altman analyzes showed that the methods correlate best when daily energy levels are ingested within the patient's needs. This FFQ is considered a good tool to be used in epidemiological studies to assess the food intake of these patients. However, caution is advised when using it with individuals with energy intakes above or below recommended daily levels.

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INTRODUCTION

Colorectal cancer is one of the most diagnosed malignancies and in 2020 it represented the second leading cause of cancer death in the world (SUNG, 2021). Although the incidence of mortality has decreased in recent decades, in some parts of the world, it continues to increase, probably due to factors such as a "westernized" diet, lifestyle and lack of infrastructure, and health care resources (NOUREDDINE, 2022; CHANG, 2021). Given this reality, performing screening is important, as it helps in carrying out tests, identifying risks and preventing diseases, and may even indicate the implementation of important public policies that help to reduce the annual mortality rate (SMITH, 2017; LADABAUM, 2022). In 2020, in Brazil, according to data collected by researchers from the National Cancer Institute (INCA, 2019a)), 41,000 cases were diagnosed, 20,540 among men, and 20,470 among women. These numbers place colorectal cancer as the second most frequent neoplasm in both men and women. The highest incidence of this disease is observed in the states of the Southeast, South and Midwest regions, which have the highest rates per 100,000 inhabitants.

The largest percentage increases are observed in the states of the North and Northeast regions (INCA, 2019b). In epidemiological studies, food intake is used to establish associations between diet and disease (SLATER, 2003) and the Food Frequency Questionnaire (FFQ) has been chosen as the usual assessment method, since it is easy to apply, has low cost and allows classification according to habitual consumption levels (WILLETT, 1994). However, the values of this consumption may vary since they are analyzed for long periods. To take such data into account, it is important to understand the differences when compared to a reference method such as a 24-hour recall (24hR) in the studied population (CADE, 2002). When the objective is to obtain information about consumption, the use of the 24hR has the advantage of being retrospective. Filled through a structured interview, it does not interfere in food intake, being appropriate for populations with low education and little concern about the quality of food ingested (CADE, 2002). The R24h application allows to obtain the amounts of portions consumed, as well as detailed information about the characteristics (preparation method, addition of salt/sugar, origin of the food), places and times of ingestion. A limitation of the method, however, is that the information from a single day does not represent the usual intake of an individual

since the variability of nutrient intake on different days gives little representativeness of the usual intake (WILLETT, 1994). Regarding the FFQ, it is a retrospective food survey method indicated when the objective is to measure the habitual consumption of individuals for long periods (weeks, months, and year), based on the report of the frequency of consumption of certain foods eaten in the past, even if recently. Its development is based on methodological procedures that will ensure the quality and validity of the reported content (WILLETT, 1994). The studies show the importance of the procedures used in the preparation of the questionnaires, their applicability, and the degree of accuracy with which they will be able to measure habitual food consumption and correlate it with a particular health condition (MARCHIONI, 2019). In this sense, it is essential to understand that in the multifactorial processes that involve environmental and genetic elements in the genesis of cancer, food plays an important protective or aggravating role that is associated with the development of colorectal lesions (DAGOSTIN, 2019). The validation of the FFQ helps to understand and correlate such factors, since being validated, it can be used in epidemiological studies. Thus, the objective of this study was to validate a FFQ for adult and elderly populations in colorectal cancer screening in the Brazilian Legal Amazon.

MATERIALS AND METHODS

We aimed to evaluate the validity of the FFQ compared to the R24h using statistical methods, and thus compare and analyze the interpersonal intakes of energy, macronutrients, and selected micronutrients of the study population according to level of intake. Thus, we applied a FFQ previously validated for adults in the Federal District of Brazil[14] and two R24h, comparing the daily estimates of nutrient intake between the methods. For 13 months, the participants were selected by convenience among patients seen in specialized institutions for colonoscopy exams, in the private and public networks of the city of Araguaína, Tocantins, Brazil. Individuals of both sexes aged 40 to 72 years, who were undergoing colorectal cancer screening and who agreed to participate in this research were included, and were excluded: a) patients with Lynch syndrome; b) patients with familial polyposis; c) patients with inflammatory bowel disease; d) individuals with investigation/diagnosis of cancer elsewhere; e) patients with other intestinal diseases unrelated to colorectal cancer; f) people with any physical disability that prevented the anthropometric measurements; g) people who were not cognitively able to answer the questions; h) history of colorectal adenoma; and i) use of colostomy. The research was approved by the Ethics Committee on Human Research of the Faculty of Health Sciences of the University of Brasília (CEP/UnB), under protocol number 610.059. The R24h was the reference method used and applied in face-to-face nutritional consultation, in which patients reported the previous day's intake and underwent anthropometric assessment. The second recall was obtained by telephone, 10 to 15 days apart from the first, both as recommended by the United States Department of Agriculture (USDA) (CONWAY, 2003). The FFQ, with questions about the foods presented in Chart 1, was applied by a trained interviewer at the same appointment where the first 24hR was obtained. For this, a FFQ composed of 70 food items was used. This FFQ was adapted according to the foods typically consumed in the Legal Amazon region, in the state of Tocantins. Individuals were asked to indicate the frequency (day-month-year), portion size (small-medium-large), and number of repetitions of each food item consumed in the past year. Portion sizes were determined in milliliters or grams. Food intake was estimated by both instruments, using the Nutrition Data System for Research (NDSR) and the Multiple Source Method (MSM). The NDSR analyzes nutrients and food groups in both the R24h and the FFQ. Thus, the software performed the daily intake estimates, calculating the energy intake levels in kilocalories (Kcal), the energy percentages represented by the macronutrients, and the contents of the following nutrients: carbohydrates, protein, lipids, iron, total dietary fiber, soluble fiber, insoluble fiber, monounsaturated fat, polyunsaturated fat, saturated fat, total omega-3 fatty acid, folic acid, vitamin B6, vitamin B12, vitamin C, vitamin D, vitamin A, methionine, selenium, calcium, and zinc. The Multiple Source Method (MSM) uses a statistical method to correct the distribution of nutrient and food consumption, estimating frequent and sporadic consumption for the group of individuals. It does this by using at least two intake measures from the R24h, with the inclusion of FFQ data. Thus, the MSM adjusted data on calories and nutrients about intrapersonal variability (HARTTIG, 2011). For anthropometry, the patient's weight was measured on a digital scale, with a capacity for 150 kg and precision of 100 g. Height was measured on a metal stadiometer, with 200 cm and precision of 1 mm, according to the criteria of Jellife et al. (1968). These data were used to calculate the body mass index (BMI), based on weight divided by height squared, classifying it according to the cut-off points established by the World Health Organization (WHO, 1995).

The sociodemographic and lifestyle questionnaire that investigated gender, marital status, education, ethnicity, alcohol consumption (patients under any alcohol intake were considered alcoholics), smoking, and physical activity practices (those who met the WHO criteria, practicing more than 150 minutes of exercise per week, were considered physically active) (WHO, 2022). Data on the characteristics of the study population were presented by descriptive statistics, containing numerical data, such as mean and standard deviation, and categorical data, represented by frequency expressed in percentage. The validity of the intake measured by the FFQ was tested by comparing the estimates of nutrient intake by the test method (FFQ) with the reference method, the R24h. To this purpose, paired t-test, Pearson correlation, and Bland-Altman regression were used at 5% significance level. The analyses were performed with R CORE TEAM statistical software, version 3.6.319. All nutrients correlated directly and positively, but significant correlations were accepted, and preferably with values between 0.4 and 0.7 for macronutrients that are abundant in food, and 0.3 to 0.7 for micronutrients that are found in small quantities (WILLET, 1994).

RESULTS AND DISCUSSION

The 56 participants interviewed were between 40 and 72 years old, with a mean age of 57.9 ± 9.5 years, and a mean BMI of 25.7 ± 4.7 kg/m², the lowest of 14.3 kg/m² and the highest of 38.7 kg/m². Of these, 27 (48.2%) of the patients were classified as overweight or with obesity. The sociodemographic characteristics of patients can be seen in Table 1.

Chart 1 - Grouping of the foods used in the study: legumes, eggs, milk and dairy products, juices, vegetables and fruits, cereals and tubers, breads, cookies and cakes, meat and fish, and miscellaneous.

Groups or Food	FFQ Foods
Legumes	Carioca or black beans, feijoada.
Eggs	Boiled egg, fried egg.
Milk and dairy products	Full-fat milk, low-fat milk, fruit yogurt, mozzarella cheese, minas frescal cheese, margarine, butter, traditional cottage cheese.
Cereals and tubers	Cooked white rice with oil and seasonings, fried potatoes, boiled potatoes, pumpkin, fried sweet potatoes, boiled sweet potatoes, yams, cooked manioc, corn couscous, oatmeal, farofa, manioc flour, cooked noodles.
Juices	Natural fruit juice (fruit pulp), fruit juice from bottles or cartons, fruit juice powder.
Vegetables and Fruit	Raw tomato, cooked carrot, avocado, banana, orange, apple, papaya or custard apple.
Breads, cookies and cakes	French bread, flat bread, hamburger, hot dog, cream cracker, stuffed cookie, homemade cake, bakery cake.
Meat and fish	Cooked fish, fried fish, cooked beef, ground beef, beef ribs, steak, roast beef, beef liver, cooked/ fried pork sausage, chicken with skin (cooked, baked and fried), skinless chicken (cooked, baked and fried), chicken fillet steak, sausage, bologna/ ham.
Diverse	Beer, regular soda, coffee, chocolate powder, olive oil, brigadeiro, milk candy, guava paste, coxinha (small snacks), cheese bread, pastel, pizza.

Table 1. Distribution of the sociodemographic characteristics of the patients

Characteristics	Total	
	Number of patients	Frequency (%)
Sex		
Male	14	25
Female	42	75
Marital status		
With partner	31	55,3
Without a partner	25	44,7
Education		
< 8 years of study	25	44,6
8 to 12 years of study	3	5,4
> 12 years of study	28	50
Ethnicity		
Black	7	12,5
Brown	35	62,5
White	12	21,4
Indigenous	2	3,6
BMI Classification		
Underweight	9	16,1
Eutrophic	20	35,7
Overweight	19	33,9
Obesity	8	14,3
Smoker		
No	52	92,9
Yes	4	7,1
Alcohol		
No	31	55,4
Yes	25	44,6
Physical activity		
No	35	62,5
Yes	21	37,5

Table 2. Average daily nutrient intake estimated by R24h and FFQ, paired test and correlation

Nutrients	24-hour food recall		Food Frequency Questionnaire		Paired Test		Correlation	
	Mean	Standard Deviation	Mean	Standard Deviation	Diferença média	p - value	r	p - value
Energy (kcal)	1707,9	444,7	2045,8	639,5	337,84	0,0000	0,49	0,0001
Protein (g)	78,0	17,8	99,1	32,7	21,14	0,0000	0,25	0,0616
Lipid (g)	59,3	19,6	59,3	23,1	0,01	0,9980	0,38	0,0038
carbohydrate (g)	219,5	67,8	284,5	96,2	65,02	0,0000	0,48	0,0001
Total Fiber (g)	18,6	8,2	23,6	9,8	5,03	0,0002	0,44	0,0007
Soluble fiber (g)	7,1	3,5	7,2	3,6	0,11	0,8613	0,15	0,2652
Insoluble fiber (g)	11,5	4,7	16,5	6,9	4,96	0,0000	0,51	0,0000
Omega 3 (g)	1,9	1,1	1,7	0,6	-0,26	0,0569	0,39	0,0027
Monounsaturated fat (g)	19,1	6,2	20,7	8,9	1,59	0,1891	0,35	0,0089
Polyunsaturated fat (g)	17,8	8,2	12,2	4,6	-5,59	0,0000	0,38	0,0043
Saturated fat (g)	17,3	5,5	20,0	8,1	2,79	0,0129	0,33	0,0130
Calcium (mg)	521,5	215,0	660,1	269,0	138,59	0,0002	0,42	0,0011
Iron (mg)	11,4	3,3	15,1	5,0	3,69	0,0000	0,47	0,0002
Selenium (mcg)	113,0	46,9	125,9	38,9	12,89	0,0799	0,23	0,1082
Zinc (mg)	10,3	2,6	14,2	5,4	3,98	0,0000	0,36	0,0058
Retinol (iu)	7884,8	2284,2	7897,7	3959,1	12,97	0,9791	0,40	0,0021
Cholecalciferol (mcg)	3,6	1,6	4,2	2,1	0,64	0,0229	0,42	0,0012
Ascorbic Acid (mg)	232,4	149,2	229,8	159,1	-2,56	0,9117	0,38	0,0038

For the estimated intakes of energy, carbohydrates, total fiber, insoluble fiber, lipids, omega-3, monounsaturated fats, polyunsaturated fats, saturated fats, calcium, iron, zinc, retinol, cholecalciferol, and ascorbic acid, significant and positive correlations were observed in the comparison between the two instruments applied, and the R values of the associations were considered acceptable from the point of view of the validation analysis of the FFQ. Only the estimated intakes for soluble fiber, selenium, and protein were below 0.30. Table 2 presents the data from this analysis. Figure 1 shows the Bland-Altman curves (1 to 6), presenting the agreement between the estimated intake values for soluble fiber, lipids, omega-3, monosaturated fats, selenium, retinol, and ascorbic acid.

It was observed that for energy estimates, the FFQ correlated best with the R24h when energy intakes were between 1500 and 2200 kcal (normocaloric intake levels). However, above or below these values, the associations were weakened. Regarding the amount of energy and nutrient intake in the food surveys applied (see Table 2), it is observed that the FFQ overestimates the values in relation to the R24h. The same results were found in the studies by El Kinany *et al.* (2018). Thus, the overestimation attributable to the FFQ may reflect the characteristics of the surveys themselves, since the FFQ quantities with the temporality (year, month, and day) represent the distorted daily reality. Such data are confirmed by viewing the Bland-Altman plots that show on average, the highest energy consumption (337.8 kcal) for the FFQ compared to that described in the R24h, with a tendency for greater differences between the methods as energy consumption increases.

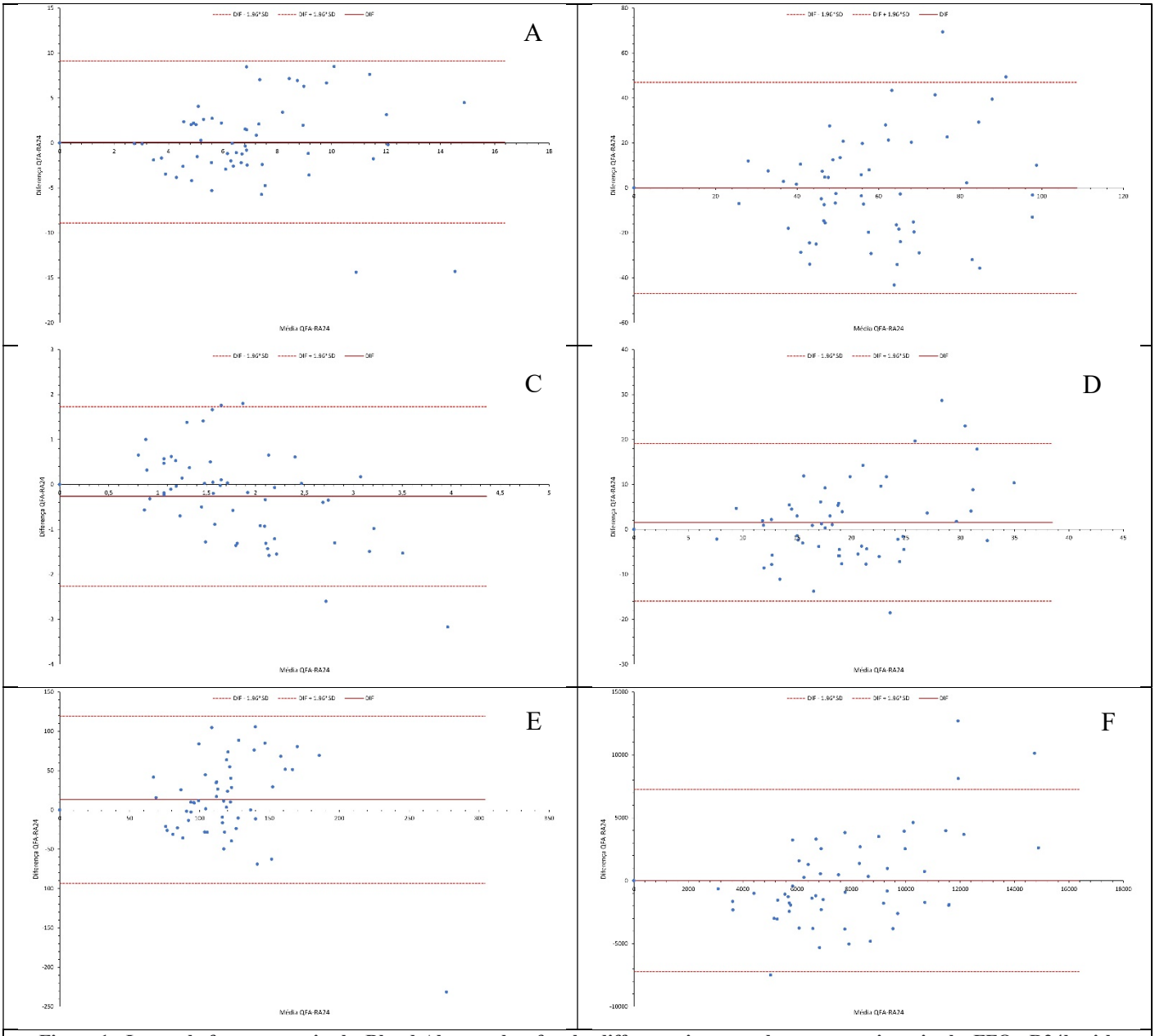

Figure 1 - Interval of agreement in the Bland-Altman plots for the difference in means between nutrients in the FFQ - R24h with upper and lower limits. (A) soluble fiber, (B) lipid, (C) omega 3, (D) monosaturated fat, (E) selenium, and (F) vitamin A

Results also reported in the literature. Some authors use questionnaire calibration to reduce the appearance of outlier values. However, in this study, we chose to keep all the information from the individuals, so that the richness of the FFQ data within the studied reality would not be lost. The correlation coefficients for nutrients estimated by the FFQ ranged from 0.15 to 0.51, lower than other studies, which reported coefficients ranging from 0.30 to 0.7122 and 0.12 to 0.7423. However, in the individual analysis of each nutrient, the tested FFQ showed a greater number of nutrients with estimates considered acceptable within the established R range (0.4 to 0.7). Bland-Altman analysis was used to evaluate the agreement between the two dietary surveys in estimating intakes of various nutrient intakes in this study (BLAND, 1999). This analysis can determine bias between the two methods and identify whether there is any systematic difference between the two and to what extent they agree (TOLLOSA, 2017). In the present study, it was observed that the differences between the intake estimates obtained by the two surveys increased as the level of energy intake moved away from normality, either upwards or downwards. Thus, the agreement between the intake estimates between the 2 methods tested for the study population becomes more robust when patients' energy intake is within the individual recommendations. It is important to emphasize that this study presents as a limitation the use of only two R24h as a reference method, due to the difficulty in obtaining information from most patients, who lived in different treatment sites. Therefore, the results should be interpreted with caution, and it is recommended that further research be carried out so that estimates of energy (kcal) confirm or even improve the concordances in the estimated intake levels.

CONCLUSION

The results demonstrate that the FFQ tested in this study has satisfactory agreement with the R24h for most nutrients. The best performance of the FFQ within a normocaloric intake level is pointed out, given the overestimation of the intakes, as the patient's consumption exceeds the energy normality levels. Thus, the FFQ developed in this study is considered a good tool to be used in epidemiological studies to evaluate the dietary intake of individuals undergoing colorectal cancer screening in the Legal Amazon.

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