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Exploratory analysis of dietary patterns of patients with gastric adenocarcinoma: a case-control study in Central Brazil

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HIGHLIGHTS

- The identification of dietary patterns is useful to show the association between diet and gastric adenocarcinoma.
- Studies on dietary patterns in Brazil are scarce, especially in the Midwest region.
- The "unhealthy" pattern was characterized by the consumption of ultra-processed foods.

ABSTRACT – Background – Diet is one of the most important modifiable risk factors for the incidence of gastric cancer. **Objective –** To carry out an exploratory analysis on the dietary patterns of individuals with gastric adenocarcinoma (AdG) in the Central Brazil region. **Methods –** This is a case-control study carried out from April 2019 to July 2022, in three reference centers for cancer treatment in Goiânia-GO. The cases were patients diagnosed with AdG, the control 1 dyspeptic patients submitted to upper digestive endoscopy and the control 2 patients without gastric complaints. In the three groups, patients aged 18 to 75 years and of both sexes were recruited. To assess food consumption, a Food Frequency Questionnaire validated for the Brazilian population was used. Dietary patterns were identified by Exploratory Factor Analysis (EFA), using principal component analysis as the extraction method, followed by Varimax rotation. **Results –** The commonality values in the EFA for the foods/food groups consumed by the cases and controls were above 0.30 for all variables. The variance explained by the model was 66.7% for cases, 60.3% for control 1 and 59.7% for control 2. Three eating patterns were identified in cases, control 1 and control 2 that explained 34, 87%, 35.41% and 33.25% respectively of the total variance. The first pattern ("healthy") was characterized by the consumption of vegetables, fruits, meat and cheese; the second ("unhealthy") for sausages, pizzas, snacks, ketchup, sweet drinks and instant noodles and the third ("prudent") rice, beans, meat and fried fish and pasta. **Conclusion –** This study identified three dietary patterns among patients with AdG and controls in the Central Brazil region. According to the identified patterns, it will be possible to establish a relationship between diet and other epidemiological measures aimed at the prevention of gastric cancer.

Keywords – Gastric neoplasms; feeding behavior; factor analysis; case and control studies.

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INTRODUCTION

Gastric adenocarcinoma (AdG) is the fifth most common malignant neoplasm and the third leading cause of cancer mortality. AdG incidence rates vary according to gender, age, ethnicity, and socioeconomic status[1-3]. For each year of the 2020-2022 triennium, approximately 21,000 new cases were estimated to occur in Brazil, 1,320 in the Midwest Region. Although mortality from AdG is declining, in 2020, this neoplasm was responsible for almost 1 million deaths worldwide[4,5].

The AdG accounts for 95% of tumors located in the stomach and is associated with several non-modifiable (genetic) and modifiable risk factors, such as *Helicobacter pylori* and *Epstein-Bar* infection, environmental factors, smoking, alcoholism and eating habits[2,3].

High consumption of salt (>5 g/day), alcohol (45> g/day), refined carbohydrates, saturated and trans fats, consumption of processed and ultra-processed foods, have been positively associated with AdG. On the other hand, the high consumption of fruits and vegetables has a protective effect on the development of AdG[1,3,6,7].

Although the eating habits of Brazilians are predominantly composed of vegetables, fruits, milk, and meat, in the last two decades, a trend has been observed in the replacement of in natura foods by ultra-processed foods (UPF)[6]. A worrying scenario, since the increased consumption of these foods is associated with an imbalance in the supply of nutrients, excessive intake of calories and adverse health outcomes, such as a higher risk of developing gastric cancer[6,8,9].

The complexity of the human diet represents a challenge for those who intend to study the relationship between diet and disease, since individuals, when eating, ingest a variety of foods and not isolated nutrients. It is likely that the complexity of the diet and the interactive and synergistic effects of food may interfere more with the risk of some diseases than individual food components[10]. Understanding the dietary patterns of a segment of the population through factor analysis can be an complementary approach to elucidate the relationships between diet and health[11].

Since diet can play a key role in gastric carcinogenesis, understanding the dietary patterns of patients with AdG is of particular interest in the field of nutritional epidemiology. It is noteworthy that in Goiás the AdG is the fifth cause of death by neoplasms[12]. Since 2017, in the state, there has been an increase in the consumption of red meat, soft drinks, beer and processed foods. In the same period, there was an increase in the incidence of AdG[13,14]. Given the scarcity of studies on dietary patterns in patients with AdG in Brazil and especially in the Midwest region of Brazil, where there has been a worsening of diet quality, the objective of this case-control study was to carry out an exploratory analysis of the dietary patterns of patients with AdG in this region of the country.

METHODS

Design, study population and data collection

This is a hospital-based case-control study of AdG that is part of a multicenter study called "Epidemiology and Genomics of Gastric Adenocarcinoma in Brazil" (FAPESP grant no. 2014/26897–0) conducted by the A.C.Camargo Cancer Center, São Paulo. This project is being carried out in five Brazilian capitals, Belém (North Region), Salvador and Fortaleza (Northeast), São Paulo (Southeast) and Goiania (Midwest Region).

In this study, patients were recruited in Goiania from April 2019 to July 2022, in public institutions (Clinical Hospital of the Federal University of Goiás HC/UFG), philanthropic institutions (Association to Combat Cancer in Goiás – Hospital Araújo Jorge - ACCG/HAJ) and private (Brazilian Center for Radiotherapy, Oncology and Mastology - CEBROM and Institute of the Digestive Apparatus – IAD).

The sample size calculation was performed using the study power (1-β) of 80%, with α error of 5% and odds ratio (OR) of 2 for the two-tailed hypothesis. Individuals of both sexes, aged between 18 and 75 years, were included in the study. Because it is an exploratory analysis of the dietary pattern, there was no pairing of cases.

The cases were patients with AdG, diagnosed in the last two years, through clinical signs, upper digestive endoscopy with biopsy, confirmed by histo-

logy and classified by ICD-O3 C.16[15]. Patients with advanced neoplasms in the terminal state without therapeutic proposal were excluded from the study.

The controls consisted of two groups, endoscopic control (control 1) and hospital control (control 2). Control 1 was dyspeptic patients submitted to upper digestive endoscopy, without diagnosis of gastric neoplastic lesions. Control 2 was composed of patients without gastric complaints and without diagnosis or suspicion of gastric cancer, treated in the gynecology, traumatology, and ophthalmology sectors of the HC/UFG.

Patients unable to answer the questionnaire due to physical or psychological reasons, those with a previous diagnosis of cancer, except for non-melanoma skin cancer, were excluded from the study.

Data were collected through a questionnaire containing sociodemographic information, lifestyle and eating habits. The questionnaires were completed using laptops and tablets by previously trained professionals. Then the information was stored in the RedCap database.

With the COVID-19 pandemic, restrictive measures emerged to ensure the health of the population, making it impossible to conduct face-to-face interviews in hospitals[16]. In this sense, they were adapted to be carried out remotely, by phone call and video call.

Study variables

The study variables sociodemographic characteristics, lifestyle, and food consumption.

Sociodemographic characteristics and lifestyle

The sociodemographic variables collected were categorized into gender (male, female), age (≤45, 46–55, 56–65, 66–75 years), level of education (up to 5 years, 6 years and high school, higher education), marital status (married, unmarried) and self-declared ethnicity (white, no white). Anthropometric indices, weight, and height were self-reported by the patient and the Body Mass Index (BMI) was automatically calculated on the RedCap platform. Participants were categorized according to BMI into underweight (<18.5 kg), eutrophic (18.5 to 24.9 kg), overweight (25.0 to 29.9 kg) and obese (30.0 to >60 kg). This categorization was made for the adult and elderly population, according to the World Health Organization (WHO) and Pan American Health Organization (PAHO), respectively[17,18]. In the lifestyle, the consumption of tobacco and alcoholic beverages was evaluated qualitatively (consumes/does not consume) and for this reason they were included only in the descriptive analyses.

Assessment of food consumption

Data on food consumption were obtained through the Food Frequency Questionnaire (FFQ) validated for the Brazilian population in patients treated for colorectal cancer[19]. The FFQ was adapted for the present study, with the inclusion of regional foods. At the time of the interviews, the patients were instructed to answer about their habitual food intake with reference to one year prior to the diagnosis of AdG.

The FFQ is composed of 120 food items and categorized into qualitative and quantitative components. In the quantitative component, the pre-defined portions were determined by household measurements or by food unit. The frequency of food consumption was evaluated by the number of times consumed (0–10) per day, week, month, or year, never or rarely, sometimes, always and don't know.

The portion sizes of each food item were classified as small (P50), medium (P75) and large (P150) with percentile distribution of weights for each food consumed in the last 24 months.

Consumption was calculated in grams/day: ((amount*portion)/unit days)) x grams. Then the foods/food groups were stratified into tertiles of consumption and regrouped by similarity of nutritional composition into 25 food groups, as shown in TABLE 1.

Food supplements were excluded because they were not considered food or drink. Regional foods such as jambu and maniçoba were disregarded due to the absence of consumption.

Dietary patterns were defined by factor analysis of the 25 food groups. The naming of patterns was based on terminologies recognized in studies of dietary patterns in Brazil and in other countries[20]. The standards were named as "healthy", "unhealthy" and "prudent".

TABLE 1. Description of the food groups used in the EFA consumed by cases and controls in the period 2019-2022 in Goiania- Goiás.

Food groups	Description of food grouping (variables – g/day)
Tuber and Vegetables	Carrot, beet, tomato, onion, chayote, pumpkin, cucumber, zucchini and eggplant.
Fruits in general	Orange, pineapple, grape, red fruits, banana, apple, papaya, melon, mango, avocado, guava, persimmon, cupuaçu, bacuri, pupunha and soursop.
Coffee and tea	Coffee and tea
Sweets in general	Plain cake, stuffed cake, whipped cream, icing, biscuit with and without filling, cereal, chocolate, gelatin, ice cream, candy, and candies.
Vegetables and cruciferous	Kale, cauliflower, cabbage, and salad.
Dark green vegetables	Peppers, parsley, lettuce, spinach, watercress, caruru and green smell.
Meat and fish (fried and baked)	Pork, red meat, chicken, beef grilled, roasted chicken, fried chicken, giblets, barbecue, fried and roasted fish, shrimp and pirarucu.
Oil and butter	Mayonnaise, butter with or without salt, margarine with or without salt, light margarine, and butter with or without light salt.
Pizza, snacks (baked and fried), french fries, popcorn and snacks;	Pizza, snacks (baked and fried), french fries, popcorn, and snacks;
Ketchup, industrialized pepper sauce, ramen noodles and cream soup	Ketchup, industrialized pepper sauce, ramen noodles and cream soup
Sweet drinks	Soda, industrialized juice, and chocolate milk.
Beans and lentils	Beans and lentils
Pasta	Pasta (with and without meat) and lasagna.
Sausages in general	Sausage, bacon, dried meat, sausage, fried meat, feijoada, sausages, processed meat, canned meat, nuggets, and hot dogs.
Rice and brown rice	Rice and brown rice
French bread and whole meal bread	French bread and whole meal bread
Cheese	Cheese
Milk	Milk
Fried egg	Fried egg
Fruit smoothies, yogurt, natural fruit juices, Minas cheese, cupuaçu juice, bacuri juice, soursop juice and açaí	Fruit smoothies, yogurt, natural fruit juices, Minas cheese, cupuaçu juice, bacuri juice, soursop juice and açaí
Egg and potato (boiled)	Egg and potato (boiled)
Farofa, tapioca, oats and peanuts	Farofa, tapioca, oats and peanuts
Soup with vegetables and meat	Soup with vegetables and meat
Spices	Salt, vinaigrette, soy drink, mayonnaise, and soy sauce.
Pequi	Pequi

EFA: Exploratory Factor Analysis.

Data analysis

The chi-square test was applied to verify differences between the independent variables of the cases and controls. The Kruskal-Wallis's test was used to compare the mean ages for case, control 1 and control 2. Both tests considered a significance level of 5%.

Dietary patterns were defined by Exploratory Factor Analysis (EFA) of the 25 food groups, with extraction by principal component analysis, using Varimax orthogonal rotation to simplify the structure.

The applicability of the factor analysis of the data was verified using the Kaiser-Meyer-Olklin (KMO) test and Bartllet's sphericity test. To determine the number of factors to be preserved as main standards, we considered the eigenvalues >1, correlation coefficient (r) >0.30, screen plot and factor interpretability. The commonality index was evaluated to indicate the percentage of variation present in each food group. Some groups had commonality values below 0.30, however, they remained in the analyzes as an adjustment. The factor loadings of the foods/food groups with the highest loads characterized each pattern.

Statistical analyzes were performed using Stata 15 (College Station, Texas, 2017) and Statistical Package for Social Science (SPSS) version 23.0 for Windows.

Ethical aspects

The research was approved by the Research Ethics Committee of the Antônio Prudente Foundation, under the consubstantiated opinion number 3,174,666 (CAAE: 53166915.9.1001.5432). All individuals who agreed to participate in the study previously signed the Free and Informed Consent Form (ICF).

RESULTS

This multicenter case-control study in Goiania – Goiás was composed of 444 individuals. A total of 49 controls were excluded from the study for not meeting the eligibility criteria. For this study, 100 cases, 158 endoscopic controls and 137 hospital controls were selected, as shown in FIGURE 1.

In the case group, 56% were male, 59% over 56 years old, 58% with 6 to 12 years of study and high school education, 73% married, 67% non-white and 43% eutrophic. Controls 1 and 2 were female (62.7% and 70.8%), aged less than or equal to 45 years (43.6% and 57.7%), 6–12 years of education and education medium (77.8% and 74.5%). Most were married (53.2% and 59.8%), non-white (76.6%, 64.2%) and eutrophic (41.1% and 43%). In cases and controls, statistical differences were observed in gender, age, and level of education ($P \leq 0.001$) according to TABLE 2.

The mean consumption (g/day) of food ingested by patients in the case and control groups were calculated. The results showed that some marker foods of unhealthy eating such as sweets in general, sausages and sweet drinks were two to three times more consumed by patients with AdG (TABLE 3).

In the Exploratory Factor Analysis, commonality values above 0.30 were included. All groups were factorable with KMO >0.50 and the sphericity guess test <0.001. The variance explained by the model for cases was 66.7%, endoscopic controls 60.3% and hospital controls 59.7% (TABLE 4) distributed into 9, 8 and 8 factors, respectively. In this study, it was decided to maintain only the three factors that most explained the total variance in food intake. The screen plot of eigenvalues retained the three main dietary patterns, separately for the cases, control 1 and control 2. The matrices of these factors are listed in TABLE 5. Three dietary patterns were identified in the study population.

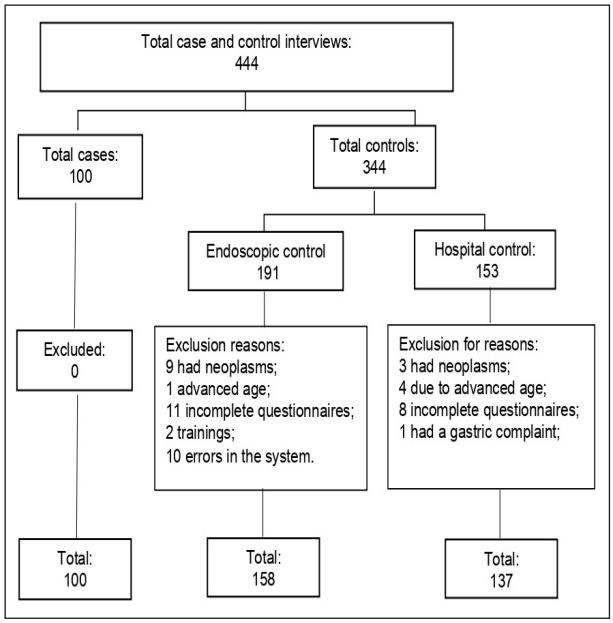

FIGURE 1. Flowchart of the patients interviewed and selection for a case-control study, in the period 2019–2022 in Goiânia, Goiás.

For the cases, the main pattern was "healthy", with a predominance of tubers and vegetables, crucifers and fruits. The other variables that constituted this pattern were vitamins, juice, yogurt and minas cheese; soup with vegetables and meat; dark green vegetables and cheese. The second "unhealthy" category was characterized by sweet drinks; sausages; pizzas, snacks and popcorn. The third "prudent" pattern consisted of oil and butter; french and wholemeal bread, and sweets in general. These three patterns explained 34.9% of the total variance (TABLE 5).

In endoscopic control, the accumulated variance was 35.4%. The first pattern called "unhealthy" showed a predominance of industrialized foods such as pizzas, snacks, french fries and popcorn; ketchup, industrial pepper sauce, instant noodles, soup; sweet drinks; sausages; spices and sweets in general. In second pattern ("healthy"), consumption of tubers and vegetables; crucifers and dark green vegetables was observed. In third pattern (prudent) the foods consumed were beans and lentils; rice and brown rice; meat, fried and roasted fish, shrimp and arapaima and pastes (TABLE 5).

TABLE 2. Distribution of cases, endoscopic control, hospital control, according to sociodemographic, smoking and alcoholics, in the period 2019–2022 in Goiânia-Goiás.

	Cases n=100	%	Endoscopic control n=158	%	Hospitalar Control n=137	%	*P*
Sex							
Male	56	56.0	59	37.3	40	29.2	≤0.001[a]
Female	44	44.0	99	62.7	97	70.8	
Age							
Age (min-max)	28–73		18–75		19–75		≤0.001[b]
Mean age (years) ±SD	56±10.0		47.3±15.5		43.9±14.2		
Age range							
≤45	16	16.0	69	43.6	79	57.7	≤0.001[a]
46–55	25	25.0	36	22.8	26	19	
56–65	43	43.0	30	19	21	15.3	
66–75	16	16.0	23	14.6	11	8	
Level of education							
Up to 5 years	23	23.0	24	15.2	7	5.1	≤0.001[a]
6 years of high school	58	58.0	123	77.8	102	74.5	
Higher education	19	19.0	11	7.0	28	20.4	
Marital status							
Married	73	73.0	84	53.2	82	59.8	0.006[a]
Not married [c]	27	27.0	74	46.8	55	40.2	
Ethnicity							
Withe	33	33.0	37	23.4	49	35.8	0.015[a]
Not white	67	67.0	121	76.6	88	64.2	
BMI (kg/m^2) [d]							
Low weight (<18,5)	24	24.0	9	5,7	9	6.6	0.084[a]
Eutrophic (18.5 a 24.9)	43	43.0	67	42.4	56	40.9	
Overweight (25.0 a 29.9)	18	18.0	43	27.2	42	30.6	
Obesity (30.0 a >60.0)	15	15.0	39	24.7	30	21.9	
Tobacco consumption							
Smoked regularly	50	50	59	37.3	44	32.1	0.018
Alcohol consumption							
Consumed alcohol regularly	59	59	82	52	67	49	0.3

[a]Pearson's X2 test; [b]Kruskal-Wallis's test; [c]single, divorced, separated, widowed or cohabiting; [d]BMI ≤60 years WHO, >60 years PAHO.

TABLE 3. Mean daily intake (g/day) of foods or food groups consumed by the cases, endoscopic control, hospitalar control, in the period 2019–2022 in Goiânia-Goiás.

Food groups	Case n=100	Endoscopic control n=158	Hospitalar control n=137
Tuber and legum	91.56	77.75	96.35
Fruit	296.93	207.86	248.12
Coffee and tea	275.70	247.73	171.94
Sweets in general	119.73	104.08	58.82
Vegetables and crucifers	29.34	23.33	29.67
Dark green vegetables	35.14	33.97	36.37
Meat and fish (fried and baked)	148.54	142.18	120.68
Oil and butter	14.89	12.76	10.68
Pizza, French fries, Popcorn and snacks	60.63	64.61	40.78
Catchup, industrialized pepper sauce, noodles and cream soup	19.05	24.48	10.95
Sweet drinks	350.80	207.37	112.41
Beans and lentils	151.87	140.93	102.86
Pasta	58.53	67.35	50.55
Sausage	101.54	90.28	70.21
Rice and brown rice	260.19	237.71	177.31
French bread and whole grain bread	49.14	42.27	39.40
Cheese	7.85	6.57	8.43
Milk	155.17	8.22	67.97
Fried egg	11.66	14.65	11.97
Vitamin, juices, yogurt and Mina's cheese	161.57	155.72	148.59
Egg and potato (boiled)	42.70	44.14	37.89
Farofa, Tapioca, Oats and Peanuts	46.83	32.41	28.90
Soup with vegetables and meat	47.76	43.48	37.89
Seasonings	4.72	6.03	2.64
Pequi	21.31	9.96	7.87

TABLE 4. Commonality for the foods/food groups consumed by the cases, endoscopic controls and hospital control in the period 2019–2022 in Goiânia-Goiás.

Food Groups	Commonality		
	Case	Endoscopic Control	Hospital Control
Tubers and vegetable	0.669	0.674	0.647
Fruit	0.630	0.557	0.658
Coffee and tea	0.742	0.629	0.585
Sweets in general	0.562	0.527	0.658
Vegetables and cruciferous	0.607	0.599	0.688
Dark green vegetables	0.690	0.595	0.632
Meat and fish (fried and baked)	0.497	0.546	0.547
Oil and butter	0.664	0.657	0.659
Pizza. snacks (fried and baked). french fries. popcorn and snacks	0.661	0.657	0.541
Ketchup. industrialized pepper sauce. ramen noodles and cream soup	0.668	0.586	0.639
Sweet drinks	0.681	0.593	0.581
Beans and lentils	0.787	0.752	0.727
Pasta	0.639	0.467	0.498
Sausages in general	0.680	0.640	0.597
Rice and brown rice	0.785	0.686	0.727
French bread and whole meal bread	0.674	0.653	0.749
Cheese	0.675	0.571	0.515
Milk	0.685	0.586	0.677
Fried egg	0.677	0.737	0.439
Fruit smoothies. yogurt. natural fruit juices. Mina's cheese	0.569	0.575	0.618
Egg and potato (boiled)	0.737	0.636	0.465
Farofa. tapioca. oats and peanuts	0.792	0.598	0.521
Soup with vegetables and meat	0.668	0.514	0.399
Spices	0.582	0.474	0.407
Pequi	0.653	0.566	0.748
KMO	0.648	0.728	0.661
Sphericity	<0.001	<0.001	<0.001
Explained Variance (%)	66.699	60.303	59.685

KMO: Kaiser-Meyer-Olklin.

TABLE 5. Factor loadings of food groups for the three dietary patterns identified in the cases, endoscopic control and hospitalar control in the period 2019–2022 in Goiânia-Goiás.

Case	Pattern			Endoscopic Control	Pattern			Hospitalar Control	Pattern		
	S	NS	P		NS	S	P		S	NS	P
Tubers and vegetables	0.788			Tubers and vegetables	0.752			Tubers and vegetables	0.764		
Vegetables and cruciferous	0.755			Vegetables and cruciferous	0.722			Vegetables and cruciferous	0.759		
Fruits	0.675			Fruits	0.694			Dark green vegetables	0.699		
Vitamin, juice, yogurt and Minas cheese	0.646			Vitamin, juice, yogurt and Minas cheese	0.694			Fried egg	0.439		
Soup with vegetables and meat	0.627			Soup with vegetables and meat	0.527			Soup with vegetables and meat	0.374		
Dark green vegetables	0.568			Dark green vegetables	0.516			Ketchup, industrialized chili sauce, instant noodles, soup		0.714	
Cheese	0.372			Cheese		0.775		Pasta		0.654	
Sweet drinks		0.794		Sweet drinks		0.735		Pizza, snacks, french fries and popcorn		0.541	
Sausages		0.754		Sausages		0.625		Sausages		0.46	
Pizza, snacks, french fries and popcorn		0.529		Pizza, snacks, french fries and popcorn		0.567		Spices		0.333	
Oil and butter			0.777	Oil and butter			0.849	Fried and roasted meat, fish, shrimp and pirarucu		0.355	
French and wholemeal bread			0.762	French and wholemeal bread			0.808	Vitamin, juice, yogurt and Minas cheese			0.755
Sweets in general			0.428	Sweets in general			0.455	Fruits			0.728
				Tubers and vegetables			0.361	Boiled egg and potato			0.429
								Farofa, tapioca, oats, and peanuts			0.379
KMO		0.648				0.728				0.661	
Accumulated variance		34.87%				35.41%				33.25%	
Bartllet's sphericity test P<0.001											

S: healthy; NS: not healthy; P: prudent; KMO: Kaiser-Meyer-Olklin.

In hospital control, the first pattern (healthy) consisted of tubers and vegetables; vegetables and crucifers; dark green vegetables; fried egg and soup with vegetables and meat. The second pattern (unhealthy) was categorized by consumption; ketchup, industrial hot sauce, instant noodles, soup; pasta; pizzas, snacks, french fries and popcorn; sausages; spices; meat, fried and roasted fish, shrimp and pirarucu. In the third pattern (prudent) it was composed of vitamin, juice, yogurt and Mina's cheese; fruits; egg and boiled potato; farofa, tapioca, oats and peanuts (TABLE 5).

DISCUSSION

In developing countries, studies that identify dietary patterns are scarce. Food consumption patterns of population groups may vary according to sex,

socioeconomic status, ethnicity, and geographic region[21]. In this study, it was possible to identify three dietary patterns, "healthy", "unhealthy" and "prudent". Interestingly, the main pattern identified in the case group was "healthy", with a predominance of vegetables and fruits. A similar pattern has been observed in other case-control studies of esophageal, gastric, and colorectal cancer adenocarcinoma[22-24].

The "healthy" pattern may be related to the recommendations of a healthier diet at the time of diagnosis, or by the spontaneous change in the onset of symptoms of this neoplasm in order to relieve gastrointestinal discomfort[25]. Another hypothesis for this finding may be due to the memory bias characteristic of case-control studies, however, it is unlikely that distorted reports have occurred since cancer patients tend to remember more easily their lifestyle habits in the past, due to the feeling of guilt of developing the disease[26].

The second pattern of cases ("unhealthy") and the third pattern ("prudent") were composed of processed foods and oil and butter, respectively. These foods are rich in fats and sugars with high energy value. A previous study carried out in São Paulo also observed a pattern characterized by the predominance of sweets[11]. A diet high in sugars, can increase down-regulate glucose, and insulin levels, and lead to obesity. These clinical conditions induce the production of inflammatory mediators associated with carcinogenesis, as well as the production of endogenous sex steroid hormones, which contribute to tumor growth[27].

In addition, the intake of these industrialized foods with unfavorable nutritional composition can increase the risk of gastric cancer by up to 50% and the risk of cancers in general by 10%[28,29]. The "unhealthy" and "prudent" patterns may be more associated with AdG than the healthy factor considered alone. It is noteworthy that a diet is composed of several food groups and there is a synergism between nutrients and their composition[30].

Most individuals in the case group consumed alcohol regularly, in this exploratory descriptive analysis, the association among alcohol consumption and AdG was not calculated. However, individuals who consume alcohol regularly prefer for salty foods, high intake of fast food and low intake of fruit. This unhealthy eating pattern represents a risk factor for AdG[31].

In the endoscopic control, the predominant pattern was "unhealthy", characterized by industrialized or ready-to-eat foods. In this group, most individuals were under 45 years old. The age of the endoscopic controls may have influenced the observed dietary pattern. As this is an economically active population, meals are possibly eaten quickly and are often limited to fast foods. Similar results were observed in young adults in the Southeast region of Brazil, where consumption of processed foods was high in this age group[32].

In the Midwest Region, the Family Budget Survey (FBS-2018) showed that in the purchase of basic foods reduces spending on beverages, processed foods and ready-to-eat meals increased[14]. The high caloric value and the unfavorable nutritional composition of this pattern may explain the gastric complaints presented by the endoscopic control and the high proportion of overweight individuals. As these are young adults, maintaining this pattern may affect gastric health and increase the risk of AdG[33].

The second factor (healthy) of the endoscopic control was composed of healthy eating markers, and the third factor (prudent) presented foods such as rice and beans, pasta, meat, fried fish, and shrimp. Fried foods and the high starch content present in this pattern are related to damage to the gastric mucosa[28].

In hospital control, the main dietary pattern was "healthy", composed mainly of tubers, vegetables; vegetables dark green and cruciferous. These foods provide a series of antioxidants, phenolic compounds, phytoestrogens, and fibers that have a protective role against gastric diseases[34].

Among the limitations of the study, we highlight the memory bias inherent to case-control studies and the application of the FFQ. To minimize these limitations, the FFQ was applied by previously trained interviewers. It is recognized that it is quite difficult to accurately remember the diet consumed in the past, however during the interview the portions were referred to in household measures that are well known and used daily. The inclusion criteria of the cases and controls were used to avoid selection bias.

The strong points of this study were the factorial analysis that allowed the identification of eating patterns in the population of the center-west of Brazil. This identification is unprecedented in patients with AdG in this region. In addition, another strong point was the remote adaptation and standardization of interviews, which characterizes a novelty in the scientific environment. This adaptation was necessary because of the limitations imposed by the pandemic caused by the Sars-CoV-2 virus[16].

CONCLUSION

In the case and hospital control groups, the predominant dietary pattern was "healthy", while in the endoscopic control it was "unhealthy". Although the predominant dietary pattern of AdG cases was healthy, this pattern is not determinant in gastric carcinogenesis. This pattern probably occurred due to the diagnosis of AdG, which favored the change to a healthier diet. Patients undergoing endoscopy should receive guidance on healthy eating to reduce the chance of AdG in this risk group. As this is an exploratory analysis, further studies are suggested to determine the scores of everyone's dietary pattern and establish a relationship with the risk of AdG in the study population. These data will be useful for nutritional interventions aimed at preventing AdG.

Authors' contribution

Santiago SB: paper writing and review; Sousa GR: paper writing and questionnaire application; Ramos AFPL: questionnaire application and database consistency analysis; Fernandes GA and Curado MP: paper review; Barbosa MS: orientation and paper writing and review.

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Santiago SB, Sousa GR, Ramos AFPL, Fernandes GA, Curado MP, Barbosa MS. Análise exploratória dos padrões alimentares de pacientes com adenocarcinoma gástrico: um estudo de caso-controle na Região Brasil Central. Arq gastroenterol. 2023;60(4):419-20.

RESUMO – Contexto – A dieta é um dos fatores de risco modificáveis mais importante para a incidência de câncer gástrico. **Objetivo –** Realizar uma análise exploratória sobre os padrões alimentares de indivíduos com adenocarcinoma gástrico (AdG) na região Brasil central. **Métodos –** Este é um estudo de caso-controle realizado no período de abril de 2019 a julho de 2022, em três centros de referência para o tratamento para câncer em Goiânia-GO. Os casos foram pacientes diagnosticados com AdG, o controle 1 pacientes dispépticos submetidos a endoscopia digestiva alta e o controle 2 pacientes sem queixas gástricas. Nos três grupos foram recrutados pacientes de 18 a 75 anos e de ambos os sexos. Para avaliar o consumo alimentar foi utilizado um Questionário de Frequência Alimentar validado para a população brasileira. Os padrões alimentares foram identificados por Análise Fatorial Exploratória (AFE), utilizando a análise de componentes principais como método de extração, seguida pela rotação Varimax. **Resultados –** Os valores de comunalidade na AFE para os alimentos/grupos alimentares consumidos pelos casos e controles ficaram acima de 0,30 para todas as variáveis. A variância explicada pelo modelo foi de 66,7%, para casos, 60,3% para o controle 1 e 59,7% para o controle 2. Foram identificados três padrões alimentares nos casos, controle 1 e controle 2 que explicaram 34,87%, 35,41% e 33,25% respectivamente da variância total. O primeiro padrão ("saudável") foi caracterizado pelo consumo de vegetais, frutas, carne e queijos; o segundo ("não saudável") por embutidos, pizzas, snacks, ketchup, bebidas doces e macarrão instantâneo e o terceiro ("prudente") arroz, feijão, carnes e peixes fritos e massas. **Conclusão –** Esse estudo identificou três padrões alimentares entre os pacientes com AdG e os controles na região Brasil central. De acordo com os padrões identificados, será possível estabelecer uma relação entre a dieta e outras medidas epidemiológicas destinadas à prevenção do câncer gástrico.

Palavras-chave – Neoplasias gástricas; comportamento alimentar; análise fatorial; estudos de caso e controle.

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