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Empirical Dietary Inflammation Index and association with metabolic and body composition changes in adults attending a nutrition outpatient clinic

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ABSTRACT

Introduction: Excess weight is associated with the secretion of pro-inflammatory cytokines, which contribute to the development of metabolic disorders and low-grade chronic inflammation. Conversely, a diet based on fresh and minimally processed foods, rich in bioactive compounds with antioxidant and anti-inflammatory properties, may help reduce the risk of these conditions.

Objective: This study aimed to evaluate the empirical dietary inflammatory index and its relationship with the presence of metabolic alterations and body composition in adults attending a nutrition outpatient clinic.

Materials and Methods: This cross-sectional, quantitative study was based on secondary data from adults of both sexes who attended a nutrition outpatient clinic in 2023. Dietary intake was assessed using a 24-hour dietary recall, from which the Empirical Dietary Inflammatory Index (EDII) was calculated. Nutritional anamnesis at the first consultation collected sociodemographic, clinical, dietary, anthropometric, body composition, and laboratory data. Metabolic alterations were defined according to criteria for dyslipidemia, hyperglycemia, increased waist circumference, and diagnosis of metabolic syndrome. Statistical analyses were performed using Jamovi software, applying Chi-square, Mann-Whitney, and Kruskal-Wallis tests (significance level of 5%). Results were expressed as medians and interquartile ranges (IQR).

Results: A total of 131 individuals were evaluated, predominantly young adult women (78.6%), with more than 12 years of education (68.7%) and belonging to middle class C (65.6%). The median EDII was -0.28 (IQR 0.36), being lower among middle-aged adults (-0.37 IQR 0.48), individuals with diagnosed pathologies (-0.33 IQR 0.37) ($p<0.050$), and those with HDL within recommended levels (-0.48 IQR 0.38) ($p=0.022$). Furthermore, individuals with metabolic syndrome exhibited a higher EDII value (0.11 IQR 0.14), particularly concerning the processed meat consumption ($p<0.050$).

Conclusion: A positive association was observed between a more inflammatory dietary pattern and lower HDL levels, as well as waist circumference indicative of cardiovascular disease risk and metabolic syndrome.

KEYWORDS

Inflammatory markers, metabolic control, body variability, inflammatory profile.

LIST OF ABBREVIATIONS

DM: Diabetes mellitus.

EDII: Empirical Dietary Inflammatory Index.

CEP: Research Ethics Committee.

CAAE: Certificate of Ethical Appreciation Presentation.

TCLE: Informed Consent Form.

BIA: Bioelectrical impedance.

WC: Waist circumference.

BMI: Body Mass Index.

WHtR: Waist-to-height ratio.

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FM: Fat mass.

FFM: Fat-free mass.

MS: Metabolic syndrome.

TBCA: Brazilian Food Composition Table.

HDL: High-density lipoprotein.

LDL: Low-density lipoprotein.

CVD: Risk for cardiovascular diseases.

PNS: National Health Survey.

NCDs: Non-communicable chronic diseases.

INTRODUCTION

In 2022, the global prevalence of overweight reached approximately 2.5 billion adults aged 18 and older, with 16% of the population classified as obese[1]. In this context, obesity is characterized as the result of a positive energy balance, where energy intake exceeds expenditure. This surplus energy is stored as fat in adipose tissue, leading to a bodily imbalance that can contribute to the development of various metabolic disorders and inflammatory processes[1].

In obesity, there is an increased secretion of cytokines, chemokines, and pro-inflammatory hormones, triggering a state of low-grade chronic inflammation[2]. As a result of this dysregulation, insulin resistance, impaired lipid metabolism, and an increased risk of metabolic syndrome may occur[3].

Metabolic syndrome is characterized by a set of interrelated factors, including diabetes mellitus (DM) and cardiovascular diseases, with a significantly increased risk in the presence of excess weight. Additionally, genetic predisposition, a sedentary lifestyle, aging, and hormonal and pro-inflammatory changes play crucial roles in its development[4].

A balanced and healthy diet primarily consists of fresh and minimally processed foods, such as fruits, vegetables, legumes, tubers, and roots sourced from nature[5].These foods generally have low caloric density and are rich in antioxidant compounds, which help neutralize free radicals naturally produced by the body during cellular metabolic processes. The balance between antioxidant intake and free radical neutralization is essential for maintaining tissue homeostasis and preventing oxidative stress. Thus, a healthy and adequate diet can provide a protective effect against cardiovascular diseases and certain types of cancer[5,6].

In this context, the need to assess changes in dietary habits and their influence on the development of inflammation and diseases has been growing. One effective way to identify this behavior is through inflammatory and dietary indices, which estimate the inflammatory dietary potential based on the intake of specific foods and nutrients. The Empirical Dietary Inflammatory Index (EDII) was originally developed in the United States and validated in Brazil, specifically in the state of São Paulo, in 2020, considering local food availability and consumption patterns[7].

Therefore, it is crucial to explore the dietary characteristics of the population to elucidate potential associations with metabolic alterations and body composition. Therefore, this study aimed to evaluate the empirical dietary inflammatory index and its association with metabolic changes and body composition in adults attending a nutrition outpatient clinic.

MATERIALS AND METHODS

The present study consisted of a cross-sectional and quantitative research, based on the collection of secondary data from nutritional anamneses conducted during the first consultation of adult individuals attending a nutrition outpatient clinic in southwestern Parana. The sample consisted of all adults who received nutritional care between March and December 2023 and met the study's inclusion criteria. Data collection took place between October 2023 and April 2024. The project was approved by the Research Ethics Committee (CEP) under review 41154814.7.0000.5564.

The study included individuals of both genders, aged between 19 and 59 years, who underwent bioelectrical impedance analysis (BIA) and laboratory tests within 30 days after their first consultation. Exclusion criteria included pregnant or lactating individuals and patients with missing anthropometric data in their medical records.

The study included individuals of both sexes, aged between 19 and 59 years, who underwent bioelectrical impedance analysis (BIA) and laboratory tests within 30 days after the first consultation. The exclusion criteria were pregnant or lactating women and patients with missing anthropometric data in their medical records.

Data collection was performed by nutrition students previously trained in the application of standardized forms and in the procedures for providing anthropometric measurements used in the assessment of nutritional status. Sociodemographic data (sex, age, education level, and income), clinical data (smoking, alcohol consumption, leisure-time physical activity, presence of pathologies that was identified through self-reporting by patients considering all conditions mentioned with a previous medical diagnosis, medication use, blood pressure, fasting glucose, and lipid profile tests), and anthropometric measurements (weight, height, and waist circumference - WC).

Family income assessment was conducted according to the criteria established by the Brazilian Association of Population Studies[8].

Body Mass Index (BMI) and WC were classified based on the cutoff points defined by the World Health Organization[1]. Additionally, the waist-to-height ratio (WHtR) was classified according to the criteria proposed by Ashwell[9]. The outpatient clinic follows standardized protocols for measuring weight and height according to Gordon, Chumlea, and Roche[10], and WC measurement was based on the technique described by Callaway et al[11]. Body composition was assessed using bioelectrical impedance analysis (BIA), using the Biodynamics 450® device, according to the manufacturer's instructions and following standard protocols for performing the exam such as fasting, hydration, and other relevant factors. The percentage of body fat obtained was classified according to the criteria of Lohman[12].

Fasting glucose, lipid profile, systolic and diastolic blood pressure, and the presence of metabolic syndrome (MS) were evaluated according to the criteria set by the International Diabetes Federation[4] and the Brazilian Society of Cardiology[13].

Dietary intake assessment was conducted through a 24-hour dietary recall, applied during the first consultation. The conversion of household food measurements to grams was performed using the household measures table for food consumption[14]. Energy intake estimation was conducted using the WebDiet software, prioritizing data from the Brazilian Food Composition Table[15].

To assess the inflammatory dietary potential, the Empirical Dietary Inflammatory Index (EDII) was calculated according to the methodology of Norde (2020), based on the consumption (in grams) of six food components divided into three groups: rice and beans; fruits, vegetables, and greens (including those used in meal preparations, excluding juices); and processed meats (such as sausages, nuggets, bacon, ham, bologna, salami, and roast beef).

The consumption in grams of each food group was multiplied by the respective coefficients: rice and beans: -0.0014923; fruits, vegetables, and greens: -0.0013381; and processed meats: 0.0044509. EDII values were adjusted for 1000 Kcal, as proposed by Willett et al[16]. Negative EDII values were considered indicative of an anti-inflammatory diet, whereas positive values represented an inflammatory diet.

Data were analyzed using descriptive and inferential statistics in Jamovi software (version 2.3.2.8). Means, medians, standard deviation, interquartile range, relative and absolute frequencies were calculated for quantitative and categorical variables, respectively. The normality of EDII values was assessed using the Shapiro-Wilk test. A 5% significance level was adopted for all hypothesis tests. Associations between categorical variables were analyzed using the Chi-square test, while comparisons of quantitative variables were performed using the Mann-Whitney and Kruskal-Wallis tests, as appropriate for ordinal variables.

RESULTS

The sample consisted of 131 individuals, predominantly female (78.6%). Most participants were young adults, aged between 19 and 39 years (68.7%), and had more than 12 years of education (65.6%). Regarding family income, 53.5% belonged to the middle class C, as shown in Table 1.

Table 1. Sociodemographic and lifestyle characterization of adults treated at a nutrition outpatient clinic (2023)

Characteristics	$\bar{x}$ (DE)	n	%
Gender			
Female		103	78.6
Male		28	21.4
Age (years)			
19 to 39	26 (5.57)	90	68.7
40 to 59	46 (5.47)	41	31.3
Schooling (years)			
≤ 12		45	34.4
> 12		86	65.6
Family income (R$)*			
A+B	9,075.71(4394)	28	21.7
C	3,500.7 (3501)	69	53.5
D+E	1,240.98 (1241)	32	24.8
Tobacco use			
Yes		12	9.2
No		109	90.8
Consumption of alcoholic beverages			
Yes		66	50.4
No		65	49.6
Physical activity			
Yes		65	49.6
No		66	50.4
Pathologies			
Yes		81	61.8
No		50	38.2
Use of medication			
Yes		73	55.7
No		58	44.3

* Family income n= 129 individuals.
A+B: (upper class and upper middle class) = R$ 5,755.23 to 21,826.74.
C (Middle class) = R$ 1,965.87 to 5,755.23.
D+E (lower classes) = R$900.60 to R$1,965.87.
DE: standard deviation.

Clinical characteristics, anthropometric indicators, body composition, and metabolic syndrome prevalence of the adults, as well as the assessment of their association by sex are presented in Table 2. A significant association was observed between sex and alterations in blood pressure, fasting glucose, triglycerides, high-density lipoprotein (HDL) levels, BMI, and MS when comparing results by gender. Men had a higher prevalence of elevated blood pressure ($p = 0.050$), high fasting glucose ($p = 0.003$), elevated triglycerides ($p \leq 0.001$), overweight ($p = 0.031$) and metabolic syndrome ($p \leq 0.001$), while women showed a higher prevalence of low HDL levels ($p \leq 0.001$).

Table 2. Clinical characteristics, anthropometric indicators, body composition, and prevalence of metabolic syndrome of adults attending a nutrition outpatient clinic (2023) and association with gender

VARIABLES	TOTAL		GENDER				p-value
			MALE		FEMALE		
	n	%	n	%	n	%	
Blood pressure*							
High	19	26.8	7	46.7	12	21.4	0.050
Normal	52	73.2	8	53.3	44	78.6	
Fasting blood glucose**							
High	10	9.9	6	26.1	4	5.1	0.003
Normal	91	90.1	17	73.9	74	94.8	
Triglycerides ***							
High	21	20.6	11	45.8	10	12.8	≤0.001
Normal	81	79.4	13	54.2	68	87.2	
LDL Cholesterol ***							
High	21	20.8	4	16.7	17	22.1	0.568
Normal	80	79.2	20	83.3	60	77.9	
HDL Cholesterol ***							
High	81	79.4	13	54.2	68	87.2	≤0.001
Normal	21	20.6	11	45.8	10	12.8	
Body mass index							
Eutrophy	46	35.1	5	17.9	41	39.8	0.031
Overweight	85	64.9	23	82.1	62	61.4	
Waist circumference							
Increased risk	75	57.3	18	64.3	57	55.3	0.396
Without risk	56	42.7	10	35.7	46	44.7	
Waist-to-height ratio							
Increased risk	78	59.5	21	75.0	57	55.3	0.060
Without risk	56	42.7	7	25.0	46	44.7	
Body fat percentage							
Acceptable	66	50.4	14	50.0	52	50.5	0.964
High	65	49.6	14	50.0	51	49.5	
Metabolic syndrome****							
Yes	29	24.8	14	51.9	15	16.7	≤0.001
No	88	75.2	13	48.1	75	83.3	

*Blood pressure n= 71 individuals; **Glycemia test n= 101 individuals; ***Lipidogram n= 102 individuals, except for LDL cholesterol n = 101 due to the impossibility of calculating it using the Friedewald formula; **** Metabolic syndrome n= 117 individuals.

Significant differences were found for age (p = 0.015), where younger adults had more positive medians, indicating a pro-inflammatory dietary pattern (-0.25) compared to middle-aged adults (-0.37). Additionally, individuals with pre-existing pathologies (p = 0.005) showed more positive scores (-0.18), reflecting a more inflammatory dietary pattern compared to those without pathologies, who had a less inflammatory score (-0.33). It was also observed that individuals with low HDL levels exhibited a more inflammatory dietary pattern (-0.27) compared to those with adequate HDL levels (-0.48) (p = 0.022). No statistically significant differences were found for the other variables studied (Table 3).

When analyzing the components of the EDII separately, in the processed meats group, individuals with MS had higher values (0.11), indicating a more pro-inflammatory dietary pattern compared to those without metabolic alterations (0.06) (p = 0.038). Regarding the components fruits, vegetables, and greens, younger individuals again showed a more positive median, meaning a more pro-inflammatory dietary characteristic (-0.17) compared to older individuals (-0.27) (p = 0.027). For the rice and beans component, individuals with pre-existing pathologies exhibited a less inflammatory dietary index (-0.186) compared to those without pathologies (-0.136) (p = 0.012). Additionally, individuals at risk for cardiovascular diseases (CVD) based on WC measurements had a more pro-inflammatory diet (-0.15) compared to those without risk (-0.19) (p = 0.043), as shown in Table 3.

The sample was stratified by the median of the EDII (-0.281/1000 kcal) to compare frequencies of clinical and anthropometric sociodemographic characteristics. (Table 4). A higher frequency of middle-aged adults was confirmed in the less inflammatory diet category (EDII < -0.281/1000 kcal), as well as individuals who reported having pathologies (p = 0.003) and those with HDL levels within the expected range (p = 0.022). Additionally, a higher frequency of adults using medication (p = 0.029) was observed in the less inflammatory dietary pattern category.

Table 3. Values of the empirical dietary inflammation index (EDII)/1000 Kcal total and components according to socioeconomic, clinical, anthropometric and body composition variables in adults attending a nutrition outpatient clinic (2023)

VARIABLES	Total EDII (N=131)		Processed meat (N=28)		Fruits, Vegetables, and Greens (N=113)		Rice and beans (N= 105)	
	n	Median (IQR)	n	Median (IQR)	n	Median (IQR)	n	Median (IQR)
TOTAL	131	-0.28 (0.36)	28	0.13 (0.15)	113	-0.20 (0.22)	105	-0.16 (0.13)
Gender*								
Female	103	-0.29^A (0.38)	19	0.08^A (0.11)	93	-0.20^A (0.25)	82	-0.16^A (0.12)
Male	28	-0.17^A (0.30)	9	0.08^A (0.15)	20	-0.12^A (0.14)	23	-0.17^A (0.18)
Age (years)*								
19 to 39	90	-0.25^A (0.29)	21	0.08^A (0.15)	73	-0.17^A (0.19)	73	-0.17^A (0.12)
40 to 59	41	-0.37^B (0.48)	7	0.08^A (0.11)	40	-0.27^B (0.30)	32	-0.14^A (0.17)
Schooling (years) *								
≤ 12	45	-0.28^A (0.41)	11	0.07^A (0,15)	39	-0.17^A (0.20)	34	-0.14^A (0.09)
>12	86	-0.28^A (0.33)	17	0.08^A (0.07)	74	-0.18^A (0.23)	71	-0.18^A (0.14)
Family income**								
A+B	28	-0.32^A (0.32)	5	0.08^A (0.03)	24	-0.21^A (0.25)	22	-0.19^A (0.14)
C	69	-0.27^A (0.35)	17	0.09^A (0.21)	60	-0.16^A (0.24)	57	-0.15^A (0.09)
D+E	32	-0.27^A (0.40)	6	0.05^A (0.06)	27	-0.17^A (0.14)	24	-0.23^A (0.22)
Tobacco use*								
Yes	12	-0.16^A (0.23)	3	0.35^A (0.19)	10	-0.15^A (0.18)	8	-0.14^A (0.08)
No	119	-0.29^A (0.38)	25	0.07^A (0.08)	103	-0.18^A (0.24)	97	-0.16^A (0.14)

Different letters (A e B) in the same column represent a statistically significant difference. *Mann Whitney test. ** Kruskal Wallis test.
IQR: Interquartile Range.

Table 3 continuación. Values of the empirical dietary inflammation index (EDII)/1000 Kcal total and components according to socio-economic, clinical, anthropometric and body composition variables in adults attending a nutrition outpatient clinic (2023)

VARIABLES	Total EDII (N=131)		Processed meat (N=28)		Fruits, Vegetables, and Greens (N=113)		Rice and beans (N= 105)	
	n	Median (IQR)	n	Median (IQR)	n	Median (IQR)	n	Median (IQR)
Consumption of alcoholic beverages*								
Yes	66	-0.28^{A} (0.40)	12	0.08^{A} (0.05)	60	-0.19^{A} (0.25)	54	-0.16^{A} (0.15)
No	65	-0.29^{A} (0.34)	16	0.06^{A} (0.18)	53	-0.16^{A} (0.19)	51	-0.16^{A} (0.11)
Physical activity*								
Yes	65	-0.29^{A} (0.38)	12	0.10^{A} (0.20)	59	-0.21^{A} (0.22)	53	-0.16^{A} (0.14)
No	66	-0.26^{A} (0.30)	16	0.07^{A} (0.05)	54	-0.16^{A} (0.22)	52	-0.16^{A} (0.13)
Pathologies								
Yes	81	-0.33^{A} (0.37)	14	0.09^{A} (0.15)	71	-0.19^{A} (0.24)	68	-0.19^{A} (0.13)
No	50	-0.18^{B} (0.23)	14	0.07^{A} (0.07)	42	-0.13^{A} (0.19)	37	-0.14^{B} (0.12)
Use of medication*								
Yes	73	-0.31^{A} (0.40)	17	0.08^{A} (0.15)	63	-0.18^{A} (0.24)	57	-0.19^{A} (0.16)
No	58	-0.24^{A} (0.30)	11	0.07^{A} (0.17)	50	-0.15^{A} (0.23)	48	-0.15^{A} (0.10)
Blood pressure*								
High	19	-0.33^{A} (0.28)	4	0.10^{A} (0.13)	16	-0.19^{A} (0.19)	15	-0.25^{A} (0.20)
Normal	52	-0.27^{A} (0.37)	11	0.05^{A} (0.04)	45	-0.18^{A} (0.24)	42	-0.15^{A} (0.10)
Fasting blood glucose*								
High	10	-0.15^{A} (0.30)	5	0.08^{A} (0.11)	7	-0.15^{A} (0.14)	7	-0.26^{A} (0.04)
Normal	91	-0.30^{A} (0.38)	19	0.08^{A} (0.12)	79	-0.19^{A} (0.24)	74	-0.17^{A} (0.14)
Triglycerides*								
High	21	-0.20^{A} (0.41)	9	0.19^{A} (0.17)	14	-0.21^{A} (0.35)	16	-0.18^{A} (0.07)
Normal	81	-0.31^{A} (0.37)	15	0.07^{A} (0.06)	73	-0.19^{A} (0.24)	66	-0.17^{A} (0.14)
LDL*								
High	21	-0.40^{A} (0.37)	3	0.20^{A} (0.11)	19	-0.23^{A} (0.23)	15	-0.21^{A} (0.17)
Normal	80	-0.28^{A} (0.35)	21	0.08^{A} (0.07)	67	-0.19^{A} (0.24)	66	-0.17^{A} (0.12)
HDL*								
Low	8	-0.27^{A} (0.39)	22	0.09^{A} (0.15)	68	-0.18^{A} (0.22)	63	-0.16^{A} (0.12)
Normal	21	-0.48^{B} (0.38)	2	0.05^{A} (0.02)	19	-0.25^{A} (0.28)	19	-0.23^{B} (0.14)
Body mass index*								
Eutrophic	45	-0.31^{A} (0.36)	8	0.09^{A} (0.17)	38	-0.23^{A} (0.22)	42	-0.21^{A} (0.15)
Overweight	86	-0.25^{A} (0.32)	20	0.08^{A} (0.09)	75	-0.16^{A} (0.21)	63	-0.19^{A} (0.12)

Different letters (A e B) in the same column represent a statistically significant difference. *Mann Whitney test. ** Kruskal Wallis test.
IQR: Interquartile Range.

Table 3 continuation. Values of the empirical dietary inflammation index (EDII)/1000 Kcal total and components according to socioeconomic, clinical, anthropometric and body composition variables in adults attending a nutrition outpatient clinic (2023)

VARIABLES	Total EDII (N=131)		Processed meat (N=28)		Fruits, Vegetables, and Greens (N=113)		Rice and beans (N= 105)	
	n	Median (IQR)	n	Median (IQR)	n	Median (IQR)	n	Median (IQR)
Waist circumference*								
Increased risk	75	-0.23^{A} (0.29)	18	0.09^{A} (0.15)	64	-0.17^{A} (0.21)	56	-0.15^{A} (0.12)
Without risk	56	-0.32^{A} (0.39)	10	0.05^{A} (0.05)	49	-0.19^{A} (0.25)	49	-0.19^{B} (0.14)
Waist-to-height ratio*								
Increased risk	78	-0.24^{A} (0.34)	18	0.09^{A} (0.15)	67	-0.16^{A} (0.23)	59	-0.15^{A} (0.12)
Without risk	53	-0.31^{A} (0.36)	10	0.06^{A} (0.05)	46	-0.19^{A} (0.22)	46	-0.18^{A} (0.14)
Body fat percentage*								
Acceptable	66	-0.30^{A} (0.35)	13	0.09^{A} (0.08)	57	-0.19^{A} (0.23)	57	-0.18^{A} (0.16)
High	65	-0.23^{A} (0.38)	15	0.05^{A} (0.13)	56	-0.16^{A} (0.21)	48	-0.16^{A} (0.11)
Metabolic syndrome*								
Yes	29	-0.23^{A} (0.29)	11	0.11^{A} (0.14)	21	-0.20^{A} (0.17)	22	-0.18^{A} (0.16)
No	88	-0.30^{A} (0.39)	14	0.06^{B} (0.05)	80	-0.19^{A} (0.25)	71	-0.16^{A} (0.14)

Different letters (A e B) in the same column represent a statistically significant difference. *Mann Whitney test. ** Kruskal Wallis test.
IQR: Interquartile Range.

Table 4. Association of socioeconomic, clinical, anthropometric, and body composition variables in adults attended at a nutrition outpatient clinic, stratified according to the median Empirical Dietary Inflammatory Index (EDII) adjusted for 1000 kcal (2023)

VARIABLE	EDII < - 0.281/1000 Kcal		EDII ≥ - 0.281/1000 Kcal		p- value
	n	%	n	%	
Gender					
Female	55	83.3	48	73.8	0.185
Male	11	16.7	17	26.2	
Age (years)					
19 to 39	40	60.6	50	76.9	0.044
40 to 59	26	39.4	15	23.1	
Schooling (years)					
≤ 12	23	34.8	22	33.8	0.904
>12	43	65.2	43	66.2	
Income					
A+B	17	26.6	11	16.9	0.414
C	32	50.0	37	56.9	
D+E	15	23.4	17	26.2	

Table 4 continuation. Association of socioeconomic, clinical, anthropometric, and body composition variables in adults attended at a nutrition outpatient clinic, stratified according to the median Empirical Dietary Inflammatory Index (EDII) adjusted for 1000 kcal (2023)

VARIABLE	EDII < - 0.281/1000 Kcal		EDII ≥ - 0.281/1000 Kcal		p- value
	n	%	n	%	
Tobacco use					
Yes	4	6.1	8	12.3	0.215
No	62	93.9	57	87.7	
Consumption of alcoholic beverages					
Yes	32	48.5	34	52.3	0.662
No	34	51.5	31	47.7	
Physical activity					
Yes	34	51.5	31	47.7	0.662
No	32	48.5	34	52.3	
Pathologies					
Yes	49	74.2	32	49.2	0.003
No	17	25.8	33	50.8	
Use of medicines					
Yes	43	65.2	30	46.2	0.029
No	23	34.8	35	53.8	
Blood pressure					
High	28	77.8	8	22.2	0.381
Normal	24	68.6	11	31.4	
Fasting blood glucose					
High	4	7.5	6	12.5	0.405
Normal	49	92.5	42	87.5	
Triglycerides					
High	9	16.1	12	25.0	0.258
Normal	47	83.9	36	75.0	
LDL					
High	14	25.9	7	14.9	0.173
Normal	40	74.1	40	85.1	
HDL					
Low	39	70.9	42	89.4	0.022
Normal	16	29.1	5	10.6	
Body mass index					
Eutrophic	26	39.4	20	30.8	0.301
Overweight	40	60.6	45	69.2	

Table 4 continuation. Association of socioeconomic, clinical, anthropometric, and body composition variables in adults attended at a nutrition outpatient clinic, stratified according to the median Empirical Dietary Inflammatory Index (EDII) adjusted for 1000 kcal (2023)

VARIABLE	EDII < - 0.281/1000 Kcal		EDII ≥ - 0.281/1000 Kcal		p- value
	n	%	n	%	
Waist circumference					
Increased risk	34	51.5	41	63.1	0.181
Without risk	32	48.5	24	36.9	
Waist-to-height ratio					
Increased risk	37	56.1	41	63.1	0.413
Without risk	29	43.9	24	36.9	
Body fat percentage					
Acceptable	35	53.0	31	47.7	0.541
High	31	47.0	34	52.3	
Metabolic syndrome					
Yes	16	29.1	13	21.0	0.310
No	39	70.9	49	79.0	

DISCUSSION

Investigations into the inflammatory dietary pattern and its relationship with clinical, metabolic, anthropometric, and body composition factors still require further exploration. Although the profile of adults seeking nutritional care was predominantly characterized by young women with over 12 years of education, belonging to the middle-income class, and having excess adipose tissue, it was observed that elevated blood pressure, fasting glucose levels, high triglyceride levels, overweight, and CVD risk based on the WHtR were more frequently found in men, except for low HDL levels. However, no differences were observed for the EDII, adjusted for 1000 kcal, between men and women. It was found that individuals aged 40–59 years who reported having pathologies and using medications had a less inflammatory EDII (p = 0.005). Meanwhile, individuals with reduced HDL levels exhibited a more pro-inflammatory EDII. The analysis of EDII components showed that individuals with MS had a more inflammatory dietary pattern concerning processed meat consumption. Middle-aged adults had a less inflammatory dietary profile regarding fruit, vegetables, and green consumption. Additionally, individuals with no pathologies and CVD risk according to WC had a less inflammatory dietary profile related to rice and bean consumption.

Previous studies conducted in nutrition outpatient clinics across different regions of the country corroborate the profile of adults observed in this study, with a predominant demand for care from women (over 80%), young adults, middle-income class, and individuals with pathologies[17,18]. Assumpção et al[19] suggested that the lower demand for nutritional care among men may be related to work schedules and a lower concern for their own health and diet quality. The high demand for care among younger individuals may be due to these clinics are affiliated with universities, where students frequently seek nutritional consultations[20]. Regarding anthropometric indicators, a study conducted with adult men and women receiving care in a nutrition outpatient clinic found that more than half of the participants were at risk for cardiovascular diseases[21], a finding similar to that of the present study. This characteristic may due to the main motivations for seeking nutritional care, such as excess body weight, increased body fat, and the presence of metabolic alterations and/or pathologies[22].

Regarding the higher prevalence of metabolic syndrome, blood pressure alterations, glycemia, and triglycerides in men, similar findings were observed in previous studies conducted in the Southeast region of Brazil[23,24].

A study involving adults of both genders treated in the public health system found a significantly higher frequency of women with controlled blood pressure (64.4%) compared to men (57.2%) (p = 0.048)[24]. Additionally, another study with 18,654 adults of both genders who sought services at a clinical diagnostic laboratory identified that 24.1% had metabolic syndrome, which was significantly more prevalent among men ($p = 0.005$). When analyzing the individual components of metabolic syndrome, men had a higher frequency of elevated fasting glucose (16.1%) compared to women (11.7%) ($p = 0.021$), along with higher percentages of elevated triglycerides (29.9% vs. 16.8%, respectively; $p = 0.001$)[23]. Regarding the higher prevalence of low HDL levels in women, Oliveira et al[25] investigated 8,952 Brazilian participants using data from the National Health Survey (PNS) and reported a higher prevalence of this condition among women (55.2%, $p \leq 0.0001$).

The associations between the presence of pathologies, medication use, and a less inflammatory dietary pattern in individuals diagnosed with chronic diseases may be due to these individuals receive guidance from various healthcare professionals to promote changes in dietary habits and lifestyle. These changes are often motivated by the need to prevent disease progression or alleviate symptoms. Azevedo et al[26] conducted a cross-sectional study with 267 healthcare professionals of both genders in Recife, assessing the consumption of risk and protective foods for non-communicable chronic diseases (NCDs). The study revealed that obese individuals had a higher intake of protective foods, suggesting that the diagnosis and treatment of obesity may encourage the adoption of a healthier diet.

Other studies worldwide have also found similarities regarding the inflammatory dietary pattern when compared to the findings of this study. A study conducted in the Middle East assessed the inflammatory dietary pattern of adult men and women using EDII and identified a positive association between a more pro-inflammatory diet and the presence of metabolic syndrome, elevated fasting glucose, increased waist circumference, and low HDL levels. However, the authors did not find significant associations for hypertension and hypertriglyceridemia[27].

Regarding the differences observed in the components of EDII, it is important to highlight that, concerning the processed meat consumption, its prevalence in the diet of the southern Brazilian population is strongly linked to the influence of European colonization, particularly by Germans and Italians. These groups brought with them traditions of producing and consuming smoked and cured foods, such as sausages, hot dogs, and salamis, which have become an essential part of the region's food culture. A study conducted in southern Brazil with 2,732 adults of both genders revealed that 85.5% of the studied population consumed processed meats regularly, with red meat-derived products being the most frequently consumed on a daily basis[28].

Young individuals tend to have a more hectic lifestyle, with intense work and study routines, often leading to the selection of more convenient food alternatives. A cross-sectional study conducted with 150 adult women in a city within the same state as this study found that middle-aged women consumed more fruits ($p < 0.001$), vegetables, and greens ($p = 0.004$) when compared to younger women[29].

Rice and beans form the foundation of the Brazilian diet, with rice being the most consumed food and beans ranking third in dietary frequency[30]. In addition to providing complementary proteins, this food combination is rich in fiber and bioactive compounds, particularly polyphenols and flavonoids, contributing to protection against oxidative stress[6].

CONCLUSION

A less inflammatory dietary pattern was identified among adults aged 40 to 59 years who reported health conditions and medication use, whereas a pro-inflammatory pattern was observed in individuals with reduced high-density lipoprotein levels. The analysis of the Empirical Dietary Inflammatory Index components revealed a stronger association between pro-inflammatory dietary patterns and processed meat consumption in individuals with metabolic syndrome. In contrast, a less inflammatory profile was observed with rice and beans consumption among those without cardiovascular disease risk, as determined by waist circumference, and with fruit, vegetable, and legume intake among individuals aged 40 to 59 years. These findings highlight the importance of incorporating fruits, vegetables, legumes, and the traditional Brazilian rice and beans combination to promote a less inflammatory dietary profile, particularly in individuals with metabolic alterations and compromised body composition.

It is worth mentioning the limitations of this study, particularly regarding sample size. While the sample is representative within the evaluated outpatient clinic, a larger sample would be necessary for more robust analyses. Additionally, the dietary assessment method used—the 24-hour recall—has inherent limitations, as it does not fully capture habitual dietary intake. However, it is worth noting that data collection was of secondary importance in this study, and the 24-hour recall is a widely used method in clinical practice.

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REFERENCES

1. World Health Organization (WHO). Obesity and overweight [Internet]. Geneva: WHO; 2020 1 March [cited 2020 Apr 01]. Available from: https://www.who.int/news-room/fact-sheets/detail/obesity-and-overweight

2. Battineni G, Sagaro G. G, Chintalapudi N, Amenta F, Tomassoni D, Tayebati S. K. Impact of obesity-induced inflammation on cardiovascular diseases (CVD). International Journal of Molecular Sciences. 2021; 22(9): 4798.

3. Jung U. J, Choi M. S. Obesity and its metabolic complications: the role of adipokines and the relationship between obesity, inflammation, in-

sulin resistance, dyslipidemia and non-alcoholic fatty liver disease. International journal of molecular sciences. 2014; 15(4): 6184-6223.

4. International Diabetes Federation. The IDF consensus worldwide definition of the metabolic syndrome [Internet]. Belgium, 2006. Available from:https://www.idf.org/e-library/consensus-statements/60-idfconsensus-worldwide-definitionof-the-metabolic-syndrome.html

5. Ministério da Saúde. Guia alimentar para a população brasileira. 2. ed. Brasília, DF: Ministério da Saúde, 2014. 156 p. Available from: https://www.gov.br/saude/pt-br/assuntos/saude-brasil/publicacoes-para-promocao-a-saude/guia_alimentar_populacao_brasileira_2ed.pdf/view

6. Koehnlein E. A, Bracht A, Nishida V. S, Peralta R. M. Total antioxidant capacity and phenolic content of the Brazilian diet: a real scenario. International journal of food sciences and nutrition. 2014; 65(3): 293-98.

7. Norde M. M, Tabung F. K, Giovannucci E. L, Fisberg R. M, Rogero M. M. Validation and adaptation of the empirical dietary inflammatory pattern across nations: A test case. Nutrition. 2020; 79: 110843.

8. Associação Brasileira de Empresas de Pesquisa - ABEP. Critério de classificação econômica Brasil. São Paulo, 2022. Available from https://abep.org/criterioBr/01_cceb_2022.pdf.

9. Ashwell M, Hsieh S. D. Six reasons why the waist-to-height ratio is a rapid and effective global indicator for health risks of obesity and how its use could simplify the international public health message on obesity. International journal of food sciences and nutrition. 2005; 56 (5):303-07.

10. Gordon, C. C. et al. Stature, recumbent length and weight. In: Lohman, T. G. et al. Anthropometric standardization reference manual. Champaign, Illinois: Human Kinetics, 3-8, 1988.

11. Callaway, C. W. Circumferences. Apud in: Lohman TG, Roche AF, Martorell R. Anthropometric Standarization Reference Manual. Human Kinetics Books: Illinois, 1988

12. Lohman T. G. Advances in Body Composition Assessment: Current Issues in Exercise Science. Monograph 3. Champaign, Illinois: Human Kinetics Publishers, 1992.

13. Précoma D. B, Oliveira G. M. M. D, Simão A. F, Dutra O. P, Coelho O. R, Izar M. et al. Atualização da Diretriz de Prevenção Cardiovascular da Sociedade Brasileira de Cardiologia – 2019. Arq. Bras. Cardiol. 2019; 113 (4): 787-891.

14. Instituto Brasileiro de Geografia e Estatística. Pesquisa de Orçamentos Familiares 2017-2018: análise do consumo alimentar pessoal no Brasil. IBGE. Rio de Janeiro, 2020.

15. Tabela Brasileira de Composição de Alimentos (TBCA). Universidade de São Paulo (USP). Food Research Center (FoRC). Versão 7.2. São Paulo, 2023. Available from: http://www.fcf.usp.br/tbca.

16. Willett W. C, Howe G. R, Kushi L. H. Adjustment for total energy intake in epidemiologic studies. Am. J. Clin. Nutr. 1997; 65 (4): 1220-28.

17. Pfaffenseller R. F, Lemaire D. C, de Almeida V. F. A, Bahamonde N. M. S. G Perfil sociodemográfico, comportamental e nutricional de adultos atendidos em uma Clínica-escola de Nutrição em Salvador, Bahia. Rev. Ciênc. Méd. Biol.(Impr.). 2017; 16 (3): 380-86.

18. Pontieri F. M, de Castro L. P. T, de Resende V. A. Relação entre o estado nutricional e o consumo de frutas, verduras e legumes de pacientes atendidos em uma clínica escola de nutrição. Ensaios e Ciência C Biológicas Agrárias e da Saúde. 2011; 15 (4).

19. Assumpção D. D, Domene S. M. Á, Fisberg R. M, Canesqui A. M, Barros M. B. D. A. Diferenças entre homens e mulheres na qualidade da dieta: estudo de base populacional em Campinas, São Paulo. Ciência & Saúde Coletiva. 2017; 22: 347-58.

20. Camera R. G, Nishiyama M. F, Koehnlein E. A, Zanuzo K, Costa L. D. C. F. Composição corporal e prevalência da síndrome do obeso eutrófico em pacientes de um ambulatório de nutrição. RBONE-Revista Brasileira de Obesidade, Nutrição e Emagrecimento. 2024; 18 (112): 185-94.

21. Pereira L. S. S, Pinto R. C. P, Azevedo V, Muzi V. R, Quintão D. Relação entre perfil antropométrico e a ingestão dietética em pacientes atendidos na clínica escola da Faculdade Pitágoras, Campus Ipatinga-MG. RBONE-Revista Brasileira de Obesidade, Nutrição e Emagrecimento. 2012; 6 (31).

22. Pereira V, de Lima Coimbra L. M. P, Mendes R. D. S. O, Dias L. P. P. Perfil de pacientes atendidos no ambulatório de nutrição de uma Clínica Escola em uma Universidade particular de São luís–MA. Revista Cereus. 2021; 13 (1):127-37.

23. Martini F. A. N, Borges,M. B, Guedes D. P. Hábito alimentar e síndrome metabólica em uma amostra de adultos brasileiros. Archivos Latinoamericanos de Nutrición. 2014; 64 (3)161-73.

24. Silva S. S. B. E. D, Oliveira S. D. F. D. S. B. D, Pierin, A. M. G. O controle da hipertensão arterial em mulheres e homens: uma análise comparativa. Revista da Escola de Enfermagem da USP. 2016; 50: 50-8.

25. Oliveira L. V. A, Santos B. N. S. D, Machado Í. E, Malta D. C, Velasquez-Melendez G, Felisbino-Mendes M. S. Prevalência da Síndrome Metabólica e seus componentes na população adulta brasileira. Ciência & Saúde Coletiva.2020; 25 (11): 4269-80.

26. Azevedo E. C. D. C, Dias F. M. R. D. S, Diniz A. D. S, Cabral P. C. Consumo alimentar de risco e proteção para as doenças crônicas não transmissíveis e sua associação com a gordura corporal: um estudo com funcionários da área de saúde de uma universidade pública de Recife (PE), Brasil. Ciência & Saúde Coletiva.2014; 19: 1613-22.

27. Shakeri Z, Mirmiran P, Khalili-Moghadam S, Hosseini-Esfahani F, Ataie-Jafari A, Azizi F. Empirical dietary inflammatory pattern and risk of metabolic syndrome and its components: Tehran Lipid and Glucose Study. Diabetology & metabolic syndrome. 2019; 11: 1-9.

28. Schneider B. C, Duro S. M. S, Assunção M. C. F. Consumo de carnes por adultos do sul do Brasil: um estudo de base populacional. Ciência & Saúde Coletiva. 2014; 19: 3583-92.

29. Spolador L. H. F, Bocchi M, Fernandes C. Y. M, de Sousa Pereira N, Moretto S. L, de Castro V. D. et al. Comparação entre o estilo de vida de mulheres de meia idade e jovens adultas. Biosaúde. 2020; 22 (2): 59-69.

30. Rodrigues R. M, Souza A. D. M, Bezerra I. N, Pereira R. A, Yokoo E. M, Sichieri R. Evolução dos alimentos mais consumidos no Brasil entre 2008-2009 e 2017-2018. Revista de Saúde Pública. 2021; 55: 4s.