REVISTA NEUROCIÊNCIAS

Original

Fruit consumption and risk of constipation in individuals with Parkinson's Disease

Consumo de frutas e risco de constipação em pessoas com Doença de Parkinson

Consumo de frutas y riesgo de estreñimiento en personas con Enfermedad de Parkinson

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Resumo

Introdução. A Doença de Parkinson (DP) é um distúrbio neurodegenerativo caracterizado por sintomas motores e não motores. Entre os sintomas não motores, a constipação intestinal é uma das manifestações gastrointestinais mais frequentemente observadas. **Objetivo.** Avaliar o consumo alimentar e a frequência de evacuação intestinal em indivíduos com DP. **Método.** Um inquérito clínico online foi realizado em maio de 2024, por meio da plataforma *Fox Insight Data Exploration Network*. Um total de 416 indivíduos com DP participou, respondendo a um questionário online. **Resultados**. A média de idade dos participantes foi de 64,7±5,22 anos (variação: 49,3–73,9), e a média de idade ao diagnóstico foi de 59,0±5,25 anos (variação: 41,9–68,3). A maioria dos participantes (88%) havia recebido o diagnóstico nos últimos 5 anos. A constipação foi relatada por 37,5% dos participantes. Observou-se uma associação significante entre o consumo de frutas e a constipação (p=0,0001). Maior consumo diário de frutas foi associado à presença de constipação, enquanto o consumo semanal foi mais comum entre aqueles sem constipação. Outras variáveis, como consumo de vegetais, tempo de diagnóstico e sexo, não apresentaram associação significante com a constipação. **Conclusão**. Estudos futuros devem investigar a adesão a padrões alimentares saudáveis, ricos em frutas e vegetais, com ênfase especial naqueles com propriedades laxativas, a fim de melhorar os sintomas gastrointestinais em indivíduos com DP.
Unitermos. Doença de Parkinson; Consumo alimentar; Constipação Intestinal

Abstract

Introduction. Parkinson's Disease (PD) is a neurodegenerative disorder characterized by both motor and non-motor symptoms. Among the non-motor symptoms, intestinal constipation is one of the most frequently observed gastrointestinal issues. **Objective.** To evaluate the dietary intake and bowel movement frequency of individuals with PD. **Method.** An online clinical survey was conducted in May 2024 through the Fox Insight Data Exploration Network platform. A total of 416 individuals with PD participated by completing the online questionnaire. **Results.** The average age of participants was 64.7±5.22 years (range: 49.3–73.9), and the average age at diagnosis was 59.0±5.25 years (range: 41.9–68.3). Most participant (88%) had been diagnosed within the last 5 years. Constipation was reported by 37.5% of the participants. A significant association was found between fruit consumption and constipation (p=0.0001). Higher daily fruit consumption was associated with the presence of constipation, while weekly consumption was more common among those without constipation. Other variables, such as vegetable intake, time since diagnosis, and sex, did not show significant associations with constipation. **Conclusion.** Future studies should investigate adherence to healthy dietary patterns rich in fruits and vegetables, specifically those with known laxative properties, to improve gastrointestinal symptoms in individuals with PD.
Keywords. Parkinson's Disease; Dietary intake; Intestinal Constipation

Resumen
Introducción. La Enfermedad de Parkinson (EP) es un trastorno neurodegenerativo caracterizado por síntomas motores y no motores. Entre los síntomas no motores, el estreñimiento intestinal es una de las manifestaciones gastrointestinales más frecuentemente observadas. **Objetivo.** Evaluar el consumo alimentario y la frecuencia de evacuación intestinal en personas con EP. **Método.** Se realizó una encuesta clínica en línea en mayo de 2024, a través de la plataforma Fox Insight Data Exploration Network. Participaron un total de 416 personas con EP, quienes respondieron un cuestionario en línea. **Resultados.** La edad media de los participantes fue de 64,7±5,22 años (rango: 49,3–73,9), y la edad media al momento del diagnóstico fue de 59,0±5,25 años (rango: 41,9–68,3). La mayoría de los participantes (88%) había sido diagnosticada en los últimos 5 años. El estreñimiento fue reportado por el 37,5% de los participantes. Se observó una asociación significativa entre el consumo de frutas y el estreñimiento (p=0,0001). Un mayor consumo diario de frutas se asoció con la presencia de estreñimiento, mientras que el consumo semanal fue más común entre aquellos sin estreñimiento. Otras variables, como el consumo de vegetales, el tiempo desde el diagnóstico y el sexo, no presentaron una asociación significativa con el estreñimiento. **Conclusión.** Futuros estudios deben investigar la adhesión a patrones alimentarios saludables, ricos en frutas y vegetales, con especial énfasis en aquellos con propiedades laxantes, con el fin de mejorar los síntomas gastrointestinales en personas con EP.
Palabras clave. Enfermedad de Parkinson; Ingesta dietética; Estreñimiento intestinal

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INTRODUCTION

Parkinson's Disease (PD) is a neurodegenerative condition influenced by genetic predisposition and environmental factors, ranking as the 14th leading cause of death in the United States[1]. It is characterized by both motor symptoms such as resting tremors, rigidity, bradykinesia, postural instability, and mobility issues—and non-motor symptoms, including depression, low self-esteem, loss of appetite, dysphagia, and intestinal constipation[2,3].

As the disease progresses, food intake may be affected, leading to nutritional complications such as weight loss and malnutrition. Contributing factors include increased energy expenditure due to involuntary movements, such as tremors

and dyskinesias, resulting in hypercatabolism[4]. Another factor that reduces treatment effectiveness and may further worsen nutritional deficits is the consumption of beef, as the amino acids from dietary proteins compete with levodopa for absorption in the gastrointestinal tract and across the blood-brain barrier, reducing the efficacy of the treatment[5].

Proper nutrition in PD helps maintain body weight, supports well-being, and may prevent complications[6,7]. Diet is a modifiable risk factor and may influence both disease progression and symptom severity. A study by Mischley et al.[8] found that ultra-processed food consumption was associated with greater PD progression, while adherence to the Mediterranean diet correlated with reduced progression and incidence[8,9].

The Mediterranean diet emphasizes whole grains, fruits, vegetables, and high water intake, favoring fresh, minimally processed foods rich in nutrients, antioxidants, and protective compounds[10-12]. Among gastrointestinal symptoms, intestinal constipation (IC) is one of the most frequent in PD, often linked to medication use[12]. Dietary fiber especially prebiotic and probiotic types, naturally found in fruits and vegetables helps maintain gut health and modulate inflammation[9].

Given that IC is more prevalent among PD patients than in the general population[8,13], understanding its relationship with dietary habits is essential. A healthy diet may promote better gastrointestinal health, regular bowel function, and improved quality of life in PD[9]. Based on this context, the

objective of this study was to evaluate the dietary intake of individuals diagnosed with PD and investigate its association with bowel movement frequency.

METHOD

Sample

This is an online clinical survey conducted on the Fox Insight (FI) Data Exploration Network website in May 2024. The FI website is a data and analytics resource for the research community, where people with PD can share information to help improve treatments and provide the scientific community with critical insights into the variability of Parkinson's disease. They were diagnosed with Parkinson's Disease according to the criteria of the Brain Bank of London (UK Parkinson's Disease Society Brain Bank).

The study involving humans were approved by the Fox insight cohort local Ethics Committes of the participating sites. Informed electronic consent was obtained with IRB approval from the New England/WCG Institutional Review Board (IRB#:120160179). The study was conducted in accordance with the local legislastion and institutional requirements. The participants provided their written informed consent to participate in this study.

The study complements traditional clinical research from in-person studies with a large cohort size and rigorous data collected from the patient's perspective over the years. FI offers a flexible design that allows the integration of various data collection modalities, enabling participation

from a broader population of patients, including those facing geographic, mobility, or transportation challenges, to contribute data. Patients participating in the research complete health questionnaires, non-motor assessments, motor assessments, quality of life evaluations, lifestyle surveys, and dietary intake reports, among others.

The study sample comprised 416 individuals from multiple countries. The distribution was as follows: United States (364 participants), Canada (15), United Kingdom (12), Australia (10), Brazil (1), Ireland (2), and one participant each from Colombia, Denmark, Germany, India, Jordan, Nepal, Singapore, Slovenia, Somalia, South Africa, Spain, and Switzerland.

Procedure

The dietary questionnaire used in this study was designed to align with the primary objective of investigating the association between dietary intake and bowel movement frequency among individuals with Parkinson's Disease. It consisted of seven categories assessing the frequency and type of food and beverage consumption, as well as eating habits and dietary preferences. Questions were selected from validated modules available on the Fox Insight platform, which are structured to explore lifestyle and nutritional factors relevant to PD symptomatology. Bowel movement frequency was also assessed to determine the presence or absence of intestinal constipation.

For this study, questionnaires on food consumption and frequency were used. Participants answered questions in seven categories of consumption (Figure 1). The first category included the following questions: "During the last week, how often did you eat raw or cooked vegetables?"; "During the last week, how often did you eat fresh fruit?"; "During the last week, how often did you eat meat?"; "During the last week, how often did you consume soy products (tofu, soy milk, tempeh, etc.)?"; "During the last week, how often did you drink coffee?"; "During the last week, how often did you drink regular soda (i.e., not diet)?"; "During the last week, how often did you consume beer?" Possible answers were recorded as: daily; 2-3 times a day; less than once a week; 2-3 times a week; and 4-5 times a week.

The second category asked: "What type of bread do you usually eat?", with the possible answers: multigrain; not sure; white bread; whole wheat bread; sourdough; rye bread; skipped question. The third category was: "During a normal week, how often do you have breakfast?", with the possible answers: 6 or more times per week; rarely; 3-4 times per week; 5-6 times per week; 1-2 times per week; never.

The fourth category asked: "During the last week, how often did you eat desserts or other sugary foods?", with the possible answers: daily; 2-3 times a day; less than once a week; 2-3 times a week; 4-5 times a week; more than 3 times a day; never, and no response. The fifth category asked: "In the last two weeks, how many servings of alcohol

did you drink per day?", with answers: none; 1; 3; between 0 and 1; 2; 4; and 5 or more.

Figure 1. Applied questionnaire

Over the past week, how often did you eat raw or cooked vegetables?	Daily	2-3x/ day	Less than 1x/week	2-3x/ week	4-5x/ week	More than 3x/day	Never	No answer
Over the past week, how often did you eat fresh fruit?	Daily	2-3x/ day	Less than 1x/week	2-3x/ week	4-5x/ week	More than 3x/day	Never	No answer
Over the past week, how often did you eat meat?	Daily	2-3x/ day	Less than 1x/week	2-3x/ week	4-5x/ week	More than 3x/day	Never	No answer
In the past week, how often did you eat soy products (tofu, soy milk, tempeh, etc.)?	Daily	2-3x/ day	Less than 1x/week	2-3x/ week	4-5x/ week	More than 3x/day	Never	No answer
Over the past week, how often did you consume coffee?	Daily	2-3x/ day	Less than 1x/week	2-3x/ week	4-5x/ week	More than 3x/day	Never	No answer
Over the past week, how often did you drink regular (i.e. non-diet) soda?	Daily	2-3x/ day	Less than 1x/week	2-3x/ week	4-5x/ week	More than 3x/day	Never	No answer
Over the past week, how often did you consume beer?	Daily	2-3x/ day	Less than 1x/week	2-3x/ week	4-5x/ week	More than 3x/day	Never	No answer
What type of bread do you usually eat?	Multigrain	Not sure	White bread	Whole wheat	Sourdough	Rye bread	Question skipped	
During a typical week, how often do you eat breakfast?	6 or more times/ week	Rarely	3-4x/week	5-6x/ week	1-2x/week	Never		
Over the past week, how often did you eat desserts or other sugary foods?	Daily	2-3x per day	Less than 1x/ week	2-3x/ week	4-5x/week	More than 3x/day	Never	Never saw the question
In the last two weeks, how many servings of alcohol did you drink each day?	None	1	3	0-1	2	4	5 or more	
Do you prefer milk or dark chocolate?	Dark chocolate	No preference	Milk chocolate	Not sure	Question skipped			
Are you vegetarian or vegan?	No answer	None of the above	Vegetarian					

The sixth category asked: "Do you prefer milk chocolate or dark chocolate?", with the answers: dark chocolate; no preference; milk chocolate; not sure, and skipped question. The last category asked: "Are you vegetarian or vegan?", with possible answers: no response; neither; and vegetarian.

Information on bowel movement frequency was also collected, with possible responses: daily; 2-3 times a week; 4-5 times a week; less than 3 times a week; once a week; and no response.

Statistical Analysis

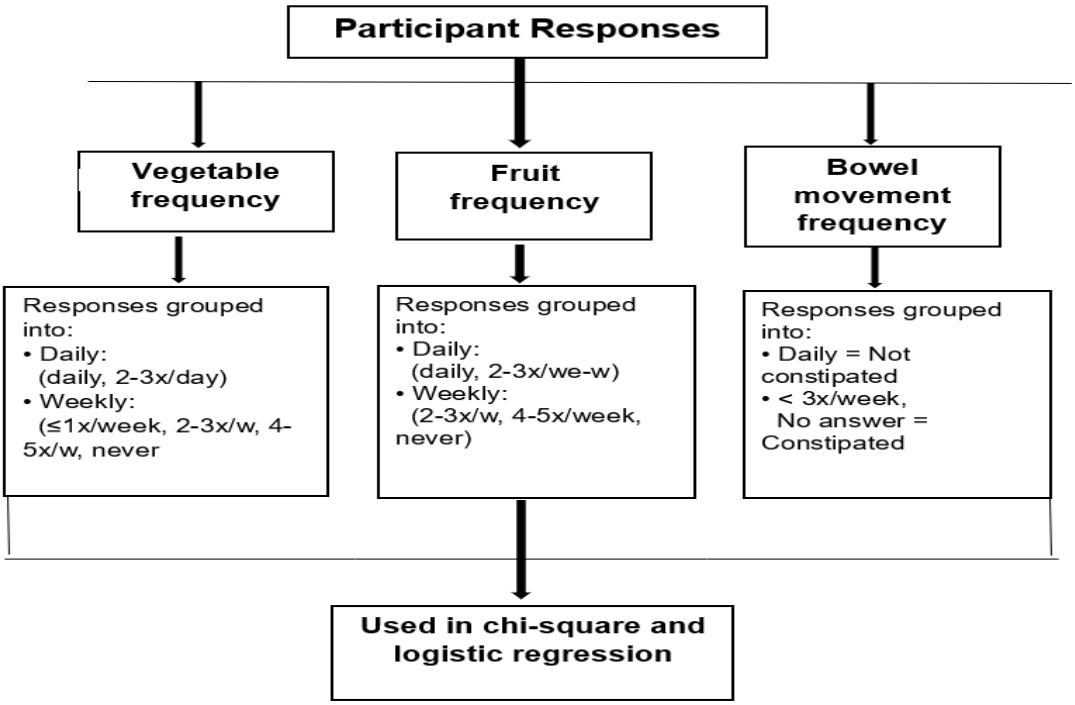
Additional data on the time since diagnosis, age at diagnosis, gender, and country of nationality were collected. Data were analyzed using BioEstat 5.0, with chi-square tests for categorical data and multiple logistic regression to assess associations between dietary intake and constipation while controlling for confounding factors These data were organized and tabulated in Excel. In the descriptive stage, measures of central tendency and dispersion were calculated for continuous variables, and frequency and proportion for categorical variables.

In the analytical stage, the chi-square test was applied to analyze categorical data and to verify significant associations between variables. Multiple logistic regression analysis was also applied to evaluate correlations between a dependent variable and independent variables. For all analyses, a statistical significance level of $p<0.05$ was considered.

To obtain vegetable and fruit consumption values in only two categories, the data were divided into daily and weekly consumption. The daily data (daily, 2-3 times per day, 3 times per day) and weekly data (less than once per week, 2-3 times per week, 4-5 times per week, never) were

summed. Constipation data were defined as either constipated or not constipated, with participants categorized based on the Rome III criteria for constipation, which defines constipation as fewer than three bowel movements per week[14] (Figure 2).

Figure 2. Flowchart of Dietary and Constipation Variables.



Based on participants' responses, those who reported (2-3 times a week; 4-5 times a week; less than 3 times a week; once a week; and no response) were considered constipated, while those who reported (daily) were considered not constipated. To refine the statistical analysis, we reanalyzed vegetable consumption with a more granular classification. While initial chi-square tests showed no statistical significance in the broader categorization (daily vs. weekly consumption; p=0.568), a refined classification

(daily, 1–3 times per week, 4–5 times per week) yielded a significant effect ($p<0.00001$), highlighting the potential impact of dietary patterns on constipation rates.

RESULTS

The research was conducted with 416 participants with PD who responded to the online study. This was a convenience sample. It was observed that the average age of the participants was 64.7±5.22 years, ranging from 49.3 to 73.9 years, while the average age at diagnosis was 59.0±5.25, ranging from 41.9 to 68.3 years. The majority of participants had been diagnosed for 5 years or less (88%). Among the 416 participants, most were male (62.25%), and in terms of country of origin, 87.5% were from the United States (Table 1).

Table 1. General Data - Profile of the participants from the Fox Insight Study (total 416).

Age		
Mean±SD	64.7±5.22	Interval 49.3 – 73.9
Age at Diagnosis		
Mean±SD	59.0±5.25	Interval 41.9 – 68.3
Years Since Diagnosis N(%)		
5 years or less	367(88.2)	
More than 5 years	49(11.77)	
Gender N(%)		
Male	259(62.25)	
Female	157(37.74)	
Country N(%)		
United States	364(87.5)	
Other countries	52(12.5)	

SD=Standard Deviation*

The results for food categories and dietary frequency are shown in the table below. Among daily consumption, the most frequently reported items were coffee (n=207), vegetables (n=185), and fruits (n=103). Meat was commonly consumed 4 to 5 times per week (n=147). Items most frequently reported as "never consumed" included soy (n=240), soda (n=292), and beer (n=232).

Multigrain bread was the most consumed type among participants (n=180). Most respondents reported having breakfast regularly (n=280), consuming sweets daily (n=106), and abstaining from alcoholic beverages in the past weeks (n=152). Dark chocolate was preferred (n=247), and for the question on vegetarian or vegan status, most participants did not provide a response (n=380; Table 2).

Table 2. Frequency and Dietary Consumption of participants in the Fox Insight Study.

Food	**Daily**	**2-3/day**	**<1 week**	**2-3/Week**	**4 to 5/Week**	**>3/day**	**Never**	
Vegetables	185	93	1	51	42	26	3	
Fruits	103	54	76	78	97	5	3	
Meat	111	13	38	97	147	1	9	
Soy	14	1	123	31	6	1	240	
Caffee	207	45	21	9	27	4	103	
Soda	17	2	67	20	17	129	292	
Beer	18	1	92	45	27	1	232	
Bread Type	**Multigrain**	**Not sure**	**White Bread**	**Whole Wheat**	**Fermented Bread**	**Rye Bread**	**Question Skipped**	
	180	7	52	125	35	10	7	
Breakfast	**6 or +/week**	**Rarely**	**3-4/week**	**5-6/sweek**	**1-2/week**	**Never**		
	280	25	33	56	12	10		
Sweets	**Daily**	**2-3/day**	**1/week**	**2-3/week**	**4-5/week**	**+ 3/day**	**Never**	**No response**
	106	18	57	82	99	6	13	35

Alcohol	**None**	**1**	**3**	**Between 0 and 1**	**2**	**4**	**5 or more**
	152	62	22	62	22	109	45
Chocolate Type	**Dark**	**No Preference**	**Milk**	**Not sure**	**Skipped Question**		
	247	50	116	2	1		
Vegetarian or vegan	**No response**	**Neither**	**Vegetarian**				
	380	35	1				

The chi-square test was conducted to analyze categorical data between variables. Fruit consumption (p=0.0001) showed a significant association with constipation. The other variables (vegetable consumption, time of diagnosis, and sex) did not show a significant association with constipation (Table 3).

Table 3. Variables and Presence of Constipation Among Participants in the Fox Insight Study.

Variables	Constipation N(%)	No Constipation N(%)	P-Value
Daily Vegetable Consumption	111(71.1)	193(74.2)	0.5681
Weekly Vegetable Consumption	45(28.8)	67(25.7)	
Daily Fruit Consumption	83(53.2)	79(30.3)	**0.0001**
Weekly Fruit Consumption	73(46.7)	181(69.6)	
5 years or > DP	136(87.1)	231(88.8)	0.7238
5 years or < DP	20(12.8)	29(11.1)	
Female	59(37.8)	98(37.6)	0.9376
Male	97(62.1)	162(62.3)	

The multiple logistic regression showed that, among the variables considered, fruit consumption (p=0.0007) is the most significant factor associated with constipation. Fruit

consumption is associated with a higher probability of constipation, while the other variables (sex, age, disease duration, vegetable consumption) do not have a significant effect on constipation (Table 4).

Table 4. Multiple Logistic Regression Between the Dependent Variable and Independent Variables Among Participants in the Fox Insight Study.

Variables	**Coefficient**	**Standard Error**	**Z**	P-Value	**Odds Ratio**	**95%CI**
Constipation	-0.8101	1.3375	...	...	...	...
Gender	0.0675	0.2145	0.3149	0.7528	1.0699	0.70 a 1.63
Current Age	0.0172	0.0203	0.8451	0.3981	1.0173	0.98 a 1.06
Disease Duration	-0.0441	0.0531	-0.8310	0.4060	0.9568	0.86 a 1.06
Vegetable Consumption	0.1095	0.2374	0.4611	0.6447	1.1157	0.70 a 1.78
Fruit Consumption	0.7279	0.2137	3.4072	**0.0007**	2.0708	1.36 a 3.15

Multiple logistic regression; Dependent Variable: Constipation. Independent Variables: Sex, Current Age (years), Duration of Diagnosis (years), Vegetable Consumption, and Fruit Consumption.

DISCUSSION

The study was conducted with 416 patients with PD, the majority being male individuals with an average age of 64 years. Men are more affected by PD than women, and the disease is more prevalent in people over 50 years old. PD affects men twice as much as women[15]. Most participants had been diagnosed for 5 years or less. Regarding the country of origin, 87.5% were from the United States.

The study evaluated the participants' dietary consumption through consumption categories and frequency. Results highlighted some foods: daily consumption by participants included coffee, vegetables, and fruits, while meat was consumed 4 to 5 times a week. Coffee

is the most consumed psychoactive beverage worldwide; this consumption by study participants might bring some benefits, as it has long been suggested that coffee can reduce or delay the development of PD[16]. Studies suggest that caffeine administration attenuates motor impairment, neuronal death, and dopamine depletion in various animal models of PD. The neuroprotective effects of caffeine are believed to be mainly due to the blockade of the adenosine A2A receptor (A2AR)[16,17].

Other foods consumed daily with positive highlights were vegetables and fruits. A study involving 1,053 men and women in the US with idiopathic PD[8] linked the diet of Parkinson's patients to disease progression and reduced incidence. This study showed that consumption of foods present in the Mediterranean diet has been associated with a reduction in PD incidence and progression, and this diet is characterized by the consumption of fresh vegetables and fruits, whole grains, legumes, seeds, olive oil, among others[9].

Vegetables and fruits, which are part of the Mediterranean diet, are rich in fibers that aid in constipation. Fibers are components that are poorly consumed in the Western diet[12,18]. Constipation is a prevalent symptom in 80% of PD patients[12]; however, in this study, only 37.5% of participants reported symptoms of constipation, and this symptom was directly affected by daily fruit consumption.

Among participants who reported constipation, 53.2% consumed fruits daily, while 46.7% consumed them weekly.

Among individuals without constipation, 30.3% consumed fruits daily, while 69.6% consumed them weekly. A p-value of 0.0001 was found, indicating a significant association between the frequency of fruit consumption and constipation. It was observed that a higher daily fruit consumption was associated with the presence of constipation, while weekly consumption was more common among those without constipation. Other variables, such as vegetable consumption, time of diagnosis, and sex, did not show a significant association with constipation.

The multiple logistic regression data confirm this relationship between fruit consumption and constipation. A coefficient of 0.7262 indicates a positive and significant relationship between fruit consumption and constipation (p-value=0.0007). The odds ratio of 2.0672 suggests that the likelihood of constipation more than doubles with increased fruit consumption.

This analysis suggests that, among the variables considered, only fruit consumption is significantly associated with constipation, indicating that people who consume more fruits have a higher chance of constipation. These results may indicate that the type of fruits consumed by the sample participants could be contributing to constipation, suggesting the presence of constipating fruits in the diet.

Fruits and vegetables contain fibers, which are classified as soluble and insoluble. Insoluble fibers are recommended for constipation as they form the fecal bulk. The recommendation for adults is approximately 25-30g;

unfortunately, most people consume only about half of the recommended fiber amount. However, it is worth noting that a fiber intake greater than 50 g/day is not necessary and can even be uncomfortable, causing abdominal distension, constipation, and flatulence[19,20].

Proper fiber intake can be achieved by consuming four or five servings of fruits and/or vegetables per day and preferring whole grains, which are rich in fiber and micronutrients[21]. It is worth noting that the type of fruits consumed could have negatively impacted the results, as some fruits may paradoxically contribute to constipation. For example, bananas contain resistant starch that can be difficult to digest, mangoes have high soluble fiber content, and apples without skins.

The questionnaires filled out by participants did not specify the types of fruits consumed daily; questions should have directed categories into "laxative fruits" and "constipating fruits" to provide better precision in the analyses. Additionally, other dietary factors should be considered[12,18].

Regarding foods that should be avoided in PD, which are considered risky[8,9], weekly consumption of red meat is highlighted. Recent studies[9-12] suggest that beef consumed in the Western diet has a high fat content and has been linked to the incidence and progression of PD due to its association with alpha-synuclein accumulation in the enteric nervous system, through immune cell activation and cross-reactivity between antigens. The accumulation of alpha-

synuclein in the form of intracellular filamentous aggregates is one of the pathological features of neurodegenerative diseases[8,22].

The major difference between the Western diet and the Mediterranean diet is the high intake of fat and processed red meat. Another relevant aspect of dietary protein is its competition with the medication levodopa (L-dopa). Dietary protein amino acids and levodopa compete for the same active transport mechanism in the gastrointestinal tract and the blood-brain barrier, leading to competition for absorption sites, which can affect the therapeutic action blocked by the proteins[23,24].

Participants who reported never consuming certain foods included soy, soda, and beer. Alcohol consumption was also low, as 152 participants indicated they had not consumed "any" alcohol in the past week. Evidence regarding the relationship between alcohol intake and PD risk is mixed[25]. A prospective cohort study with 694 PD patients[26] found no association between alcohol consumption and the development of PD in general; however, it was related alcohol consumption to increased PD progression[8].

A positive highlight in the research was the consumption of bread, specifically multigrain bread, a fiber-rich food present in the Mediterranean diet and associated with reduced constipation[9,27]. When consumed properly, it provides benefits for PD treatment. It is worth noting that this food is part of the Western breakfast, and many study participants reported having this morning habit. A cohort

study in Pennsylvania reiterated that diet quality, meal frequency, and regularity were associated with a lower risk of PD progression[9,28].

Most participants consumed more "dark chocolate" than "milk chocolate," which is more beneficial and healthier since dark chocolate contains little or no milk. Prospective studies[9,25] suggested that high consumption of milk and dairy products may increase PD risk. One proposed explanation for the association between PD risk and milk intake is its uric acid-lowering effect; lower uric acid levels in the central nervous system are associated with higher PD incidence. Additionally, dairy products contain pesticides with neurotoxic pro-oxidant properties that worsen disease progression[8,25].

Conversely, a negative highlight in the research was the consumption of sweets; most participants reported consuming them daily. This consumption is considered risky as sweet foods have high sugar content, which requires high metabolic demand from neurons, making them more susceptible to oxidative damage, with a negative impact on neurodegeneration[29].

Regarding vegetarianism or veganism, nearly all participants did not respond. In general, vegan and vegetarian diets are based on a large amount of plant foods, with the former excluding any animal-based food products, while the latter includes seafood, dairy, and eggs, along with vegetables, fruits, whole grains, legumes, nuts, and seeds[30]. Limited previous epidemiological studies have suggested

lower PD rates in societies that mainly follow vegetarian and vegan diets[31,32].

This study presents some limitations that should be considered. The main one is the lack of detailed information regarding the specific types of fruits and vegetables consumed by participants, since data collection was based only on the frequency of consumption by food groups. This limitation hinders the ability to distinguish between foods with laxative and constipating effects, particularly in the case of fruits. Additionally, important factors that may influence constipation, such as water intake, physical activity, the presence of gastrointestinal diseases, anxiety, depression, and socioeconomic and educational conditions were not assessed.

Another significant limitation is the absence of clinical variables, such as Parkinson's disease severity (e.g., MDS-UPDRS and Hoehn-Yahr scales), comorbidities, and medication usage. Although meat consumption was high among participants, possible protein intake restrictions associated with antiparkinsonian medication use were not investigated. This represents an important gap, considering that pharmacotherapy may affect dietary patterns and the nutritional status of these patients. Future studies should consider these variables to provide a more comprehensive understanding of the relationship between diet, intestinal constipation, and the progression of PD.

CONCLUSION

In this study, fruit consumption was associated with a higher likelihood of constipation, while other variables (sex, age, disease duration, vegetable consumption) did not show a statistically significant effect on this symptom. This study evaluated the consumption and frequency of food in PD patients, and participants generally consumed foods considered protective, along with some risky foods.

This demonstrates that with appropriate guidance, it is possible to make changes and minimize potential risks associated with symptoms such as constipation. Future studies should be conducted to verify adherence to a healthy diet, rich in fruits and vegetables, but specifically targeting laxative fruits and vegetables to improve gastrointestinal symptoms.

REFERENCES

1.Willis AW, Roberts E, Beck JC, Fiske B, Ross W, Savica R, *et al*. Parkinson's Foundation P4 Group. Incidence of Parkinson disease in North America. NPJ Parkinsons Dis 2022;8:170. https://doi.org/10.1038/s41531-022-00410-y

2.Dickson DW. Neuropathology of Parkinson disease. Parkinsonism Relat Disord 2018;46(Suppl 1):S30-3. https://doi.org/10.1016/j.parkreldis.2017.07.033

3.De Rui M, Inelmen EM, Trevisan C, Pigozzo S, Manzato E, Sergi G. Parkinson's disease and the non-motor symptoms: hyposmia, weight loss, osteosarcopenia. Aging Clin Exp Res 2020;32:1211-8. https://doi.org/10.1007/s40520-020-01470-x

4.Ma K, Xiong N, Shen Y, Han C, Liu L, Zhang G, *et al*. Weight Loss and Malnutrition in Patients with Parkinson's Disease: Current Knowledge and Future Prospects. Front Aging Neurosci 2018;10:1. https://doi.org/10.3389/fnagi.2018.00001

5.Fracasso BM, Moraes MB, Gomez R, Hilbig A, Rabito EI. Protein intake and the use of levodopa in patients with Parkinson's disease. Rev ChilNutr 2013;40:102-6. https://doi.org/10.4067/S0717-75182013000200001

6.Bazán-Rodríguez L, Cruz-Vicioso R, Cervantes-Arriaga A, Alcocer-Salas A, Pinto-Solís D, Rodríguez-Violante M. Malnutrition and Associates Motor and Non-motor factors in People with *Parkinson's* disease. Rev Invest Clin 2020;72:293–9. https://doi.org/10.24875/RIC.20000010

7.Paul BS, Singh T, Paul G, Jain D, Singh G, Kaushal S, *et al*. Prevalence of Malnutrition in Parkinson's Disease and Correlation with Gastrointestinal

Symptoms. Ann Indian Acad Neurol 2019;22:447-52. https://doi.org/10.4103/aian.AIAN_349_18
8.Mischley LK, Lau RC, Bennett RD. Role of Diet and Nutritional Supplements in Parkinson's Disease Progression. Oxid Med Cell Longev 2017;2017:6405278. https://doi.org/10.1155/2017/6405278
9.Bisaglia M. Mediterranean Diet and Parkinson's Disease. Int J Mol Sci 2022;24:42. https://doi.org/10.3390/ijms24010042
10.Ying AF, Khan S, Wu Y, Jin A, Wong ASY, Tan EK, *et al*. Dietary Antioxidants and Risk of Parkinson's Disease in the Singapore Chinese Health Study. Mov Disord 2020;35:1765-73. https://doi.org/10.1002/mds.28173
11.Hughes KC, Gao X, Kim IY, Rimm EB, Wang M, Weisskopf MG, *et al*. Intake of antioxidant vitamins and risk of Parkinson's disease. Mov Disord 2016;31:1909-14. https://doi.org/10.1002/mds.26819
12.Rusch C, Beke M, Tucciarone L, Nieves C, Jr Ukhanova M, Tagliamonte MS, *et al*. Mediterranean Diet Adherence in People With Parkinson's Disease Reduces Constipation Symptoms and Changes Fecal Microbiota After a 5-Week Single Arm Pilot Study. Sec Frontiers Neurology 2021;12:794640. https://doi.org/10.3389/fneur.2021.756538
13.Knight E, Geetha T, Burnett D, Babu JR. The Role of Diet and Dietary Patterns in Parkinson's Disease. Nutrients 2022;14:4472. https://doi.org/10.3390/nu14214472
14.Thompson WG, Longstreth GF, Drossmand DA, Heaton KW, Irvine EJ, Müller-Lissner SA. Functional bowel disorders and functional abdominal pain. Gut 1999;45*(*Suppl 2*):*1143-7. https://doi.org/10.1136/gut.45.2008.ii43
15.Cerri S, Mus L, Blandini F. Parkinson's Disease in Women and Men: What's the Difference? J Parkinsons Dis 2019;3:501-15. https://doi.org/10.3233/JPD-191683
16.Khadrawy YA, Salem AM, El-Shamy KA, Ahmed EK, Fadl NN, Hosny EN. Neuroprotective and Therapeutic Effect of Caffeine on the Rat Model of Parkinson's Disease Induced by Rotenone. J Diet Suppl 2017;14:553-72. https://doi.org/10.1080/19390211.2016.1275916
17.Nehlig A. Interindividual Differences in Caffeine Metabolism and Factors Driving Caffeine Consumption. Pharmacol Rer 2018;70:384-411. https://doi.org/10.1124/pr.117.014407
18.Schwiertz A, Spiegel J, Dillmann U, Grundma NN, Bürmann, J, Faßbender K, *et al*. Fecal markers of intestinal inflammation and intestinal permeability are elevated in Parkinson's disease. Parkinsonism Relat Disord 2018;50:104-7. https://doi.org/10.1016/j.parkreldis.2018.02.022
19.Bellini M, Gambaccini D, Usai-Satta P, Bortoli N, Bertani L, Marchi C. Irritable bowel syndrome and chronic constipation: Fact and fiction. World J Gastroenterol 2015;21:11362-70. https://doi.org/10.3748/wjg.v21.i40.11362
20.Bellini M, Tonarelli S, Barracca F, Rettura F, Pancetti A, Ceccarelli L, *et al*. Chronic Constipation: Is a Nutritional Approach Reasonable? Nutrients 2021;13:3386. https://doi.org/10.3390/nu13103386
21.Bernaud FR, Rodrigues TC. Dietary fiber – Adequate intake and effects on metabolism health. Arq Bras Endocrinol Metab 2013;57:397-405. https://doi.org/10.1590/S0004-27302013000600001
22.Metcalfe-Roach A, Yu AC, Golz E, Cirstea M, Sundvick k, Kliger D, *et al*. MIND and Mediterranean Diets Associated with Later Onset of Parkinson's Disease. Mov Disord 2021;36:977-84. https://doi.org/10.1002/mds.28464
23.Leta V, Klingelhoefer L, Longardner K, Campagnolo M, Levent HC, Aureli F, *et al*. International Parkinson and Movement Disorders Society Non-Motor

Parkinson's Disease Study Group. Gastrointestinal barriers to levodopa transport and absorption in Parkinson's disease. Eur J Neurol 2023;30:1465-80. https://doi.org/10.1111/ene.15734
24.Perfeito R, Rego AC. Papel da Alfa-sinucleína e da Disfunção Mitocondrial associada à Doença de Parkinson. Rev Neurocienc 2012;20:273-84. https://doi.org/10.34024/rnc.2012.v20.8280
25.Tosefsky KN, Zhu J, Wang YN, Lam JST, Cammalleri A, Appel-Cresswell S. The Role of Diet in Parkinson's Disease. J Parkinsons Dis 2024;14:S21-34. https://doi.org/10.3233/JPD-230264
26.Peters S, Gallo V, Vineis P, Middleton LT, Forsgren L, Sacerdote MD, *et al*. Alcohol Consumption and Risk of Parkinson's Disease: Data from a Large Prospective European Cohort. Desordem Mov 2020;35:1258-63. https://doi.org/10.1002/mds.28039
27.Molsberry S, Bjornevik K, Hughes KC, Healy B, Schwarzschild M, Ascherio A. Diet pattern and prodromal features of Parkinson disease. Neurology 2020;95:e2095-108. https://doi.org/10.1212/WNL.0000000000010523
28.Molsberry S, Bjornevik K, Hughes KC, Healy B, Schwarzschild M, Ascherio A. Diet pattern and prodromal features of Parkinson disease. Neurology 2020;95:e2095-108. https://doi.org/10.1212/WNL.0000000000010523
29.Liu YH, Jensen GL, Na M, Mitchell DC, Wood CGD, Still C, *et al*. Diet Quality and Risk of Parkinson's Disease: A Prospective Study and Meta-Analysis. J Parkinsons Dis 2021;11:337-47. https://doi.org/10.3233/JPD-202290
30.Seidl SE, Santiago JA, Bilyk H, Potashkin JA. The emerging role of nutrition in Parkinson's disease. Front Aging Neurosci Nutr Parkinsons Dis 2014;6:36. https://doi.org/10.3389/fnagi.2014.00036
31.Kent G, Kehoe L, Flynn A, Walton J. Plant-based diets: a review of the definitions and nutritional role in the adult diet. Proc Nutr Soc 2022;81:62-74. https://doi.org/10.1017/S0029665121003839
32.McCarty MF. Does a vegan diet reduce risk for Parkinson's disease? Med Hypotheses 2001;57:318-23. https://doi.org/10.1054/mehy.2000.1321