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ORIGINAL ARTICLE

## FODMAP Rich Foods Intake Related to Gastrointestinal Symptoms in Healthy Adults

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### ABSTRACT

**AIM:** Investigate the relationship between the frequency of FODMAP rich food intake and gastrointestinal symptoms in healthy adults.

**MATERIALS AND METHODS:** A cross-sectional study was conducted with healthy individuals based on an electronic survey platform. Inclusion criteria included ages between 19 and 75, both genders, resident of Rio de Janeiro, not have been previously diagnosed with irritable bowel syndrome or other gastrointestinal diseases and that agreed with the informed consent form. Stool appearance and consistency was evaluated using the Bristol Scale,

bowel movement frequency using a closed question, frequency of specific gastrointestinal symptoms (abdominal pain, abdominal distension, abdominal discomfort, flatulence and intestinal or stomach sounds) through a Likert scale, and FODMAP rich food intake using a food frequency questionnaire.

**RESULTS:** Flatulence was the most frequent symptom reported, along with intestinal/stomach sounds and abdominal discomfort. Despite this profile, stool consistency and bowel movements were consistent with the expected for a healthy individual. The most frequently consumed FODMAP rich foods were onions and/or garlic; biscuits, cakes and breads; cheese; milk and legumes. The presence of legumes, rich in oligosaccharides, as one of the most cited foods reflects the dietary pattern of the population, differently from other studies.

**CONCLUSION:** Even in the absence of gastrointestinal disorders FODMAP could elicit uncomfortable symptoms and the identification of the particular foods responsible could contribute to a more individualized dietary advice.

**Key words:** FODMAP; Dietary intake; Gastrointestinal symptoms

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### INTRODUCTION

Functional gastrointestinal disorders, such as irritable bowel syndrome (IBS), can be characterized by recurrent abdominal pain associated with altered bowel movements, such as constipation, diarrhea, alteration between both, as well as flatulence and abdominal distension. The pathophysiology of some disorders is yet poorly understood and the symptoms may not be specific to a disease, occurring occasionally even in healthy individuals. The symptoms of IBS, for example, are predominant in 10-20% of the general

population, affecting more females, but it is estimated that a high proportion of the population suffers from IBS, but is not properly diagnosed<sup>[1]</sup>. Therefore, in many situations treatment involves managing the predominant symptoms and the severity of the complaints<sup>[2,3]</sup>.

Functional gastrointestinal disorders' treatment depends on the clinical presentation, but due to the variation of symptoms, the measures to be taken should be individualized. The treatment used in clinical practice includes pharmacological approaches such as laxative or antispasmodic drugs, and non-pharmacological, such as lifestyle modification through physical exercise and dietary changes. Diet has received much attention recently, since some foods were suggested to be strongly related to the development and aggravation of these gastrointestinal symptoms<sup>[4]</sup>.

A dietary intervention that has shown promising effects in IBS treatment is the reduction of FODMAP RICH foods. FODMAPs (fermentable oligosaccharides, disaccharides, monosaccharides and polyols) are a group of short chain carbohydrates, such as fructose, lactose, fructan and galactans, and sugar alcohols such as sorbitol, mannitol, xylitol, and maltitol. All together, they comprise classes of small molecules that are osmotically active, promoting intestinal malabsorption and rapid fermentation in the intestine, and through these mechanisms induces symptoms that may characterize IBS<sup>[4,5]</sup>.

The potential benefits of a restricted FODMAP diet was first shown in a retrospective study, where 74% of patients with IBS and fructose malabsorption responded positively to the restriction of fructose and fructans. Latter, a randomized, double-blind, placebo-controlled study, with the same target group, included fructose and fructan, alone or in combination. Symptoms were induced in 4 of 5 participants with individual or combined solutions of FODMAPs compared to less than 1 in 5 with placebo (glucose)<sup>[6,7]</sup>.

Dietary modifications, however, depends also to the adherence to the protocol for treatment success. Studies suggest that adherence to a low FODMAP diet may reach 75% and result in improvement of symptoms by more than 50% of patients suffering from IBS, as well as other intestinal disorders. However, for some patients the implementation of this diet can still be difficult due to its complexity and restriction<sup>[1,8]</sup>. Despite being a recent issue, most studies have shown the relationship between consumption of FODMAP rich foods and gastrointestinal symptoms in IBS patients. Thus, the present study aims to evaluate the relationship between the consumption of FODMAP rich foods and common gastrointestinal symptoms in healthy adults.

## METHODS

A cross-sectional study was conducted with adults who have not been previously diagnosed with IBS or any other gastrointestinal diseases. Inclusion criteria included individuals between ages 19 and 75, of both sexes and who agreed to participate in the study by signing the free and informed consent form. Were excluded those who did not correctly fill out the questionnaire, those who already had been diagnosed with IBS or other gastrointestinal diseases and/or were not residents of the state of Rio de Janeiro. Informed consent was obtained from all individual participants included in the study which proceeded to the electronic survey.

Gastrointestinal (GI) symptoms were evaluated using a Likert scale based on Guyonnet *et al.*<sup>[9]</sup> (2007). Stool form and consistencies was assessed according to the Bristol Scale. Evacuation frequency was evaluated by the closed question "How frequent do you usually have a bowel movement?" having as answer options: "alternation between diarrhea and constipation", "Less than 3 bowel movements /

week"; "Alternate days"; "daily"; "More than 3 stools / day".

Participants completed a qualitative Food Frequency Questionnaire (FFQ) adapted with the foods with higher amounts of FODMAP according to literature, not considering food portion, but rather the frequency usually consumed. The following frequencies ("never", "1 times a month", "2 to 3 times a month", "1 time a week", "4 a 5 times a week", "1 times a day" and "2 or more times a day") were available.

All procedures performed in studies involving animals were in accordance with the ethical standards of the institution or practice at which the studies were conducted being approved by the University Hospital Ethical Committee under the CAAE number 68575517.4.0000.5257. Medians, standard deviation and frequency analysis of the data was done using Microsoft Excel spreadsheets.

## RESULTS

One hundred sixty three responses were obtained through the electronic survey. After exclusion of the individuals that did not fit the inclusion/exclusion criteria, there were 134 valid participants. Of those, 110 (82.1%) were females and 24 (17.9%) were males. The majority of the sample (47.0%) was between 20 and 29 years of age followed by individuals between 30 and 49 years (39.6%) (Table 1). Participants were questioned about the use of probiotic, fiber and/or symbiotic supplements, of which only 17.2% ( $n = 23$ ) disclaimed the use of probiotic supplements and 3.7% ( $n = 5$ ) reported the use of fiber supplements. No participant reported the use of symbiotic supplements.

Stool consistency of the majority of the sample was considered "healthy", with 69.4% reporting types 3 and 4 in the Bristol Scale, the same observed for bowel movements were 67.9% had daily evacuations (Table 2).

Approximately 33% reported "abdominal pain" at least in one day of the week, while the prevalence of "abdominal discomfort", at least in one day of the week, was considerably higher, ranging 64%. The most frequent gastrointestinal symptoms were "flatulence" and "intestinal or stomach" with more than 10% of the population study reporting daily episodes (Table 3).

Foods most frequently consumed, with more than 25% of the population having the habit of consuming at least once a day, were: onion and / or garlic (73.8%), biscuits, cakes and breads (45.1%), cheese (39.5%), milk (38.8%), and beans (38.1%) (Table 4).

## DISCUSSION

The impact of FODMAP rich foods in individuals with IBS or other intestinal disorder is already known, with FODMAP restricted diets being used to reduce symptoms. Considering that our subjects were healthy individuals, at least without previous diagnosis of IBS or other GI disorder, the presence of GI symptoms was still observed. We can suggest that there is no indicative of non-diagnosed IBS since self-evaluation of the appearance and consistency of feces, by Bristol Scale, showed most individuals reporting types 3 and 4. This profile suggests that constipation or dry stools or diarrheal evacuations are not frequent in the sample studied. These data suggest that even if abdominal discomfort is frequent in most individuals, this does not cause changes in the appearance of stool or frequency of bowel movements. The reported discomfort may be due, for example, to increased intestinal gas production since flatulence was cited at least two to three times a week by half the population (50.7%) (Table 2).

Böhn, *et al.*<sup>[11]</sup> (2013) evaluated the occurrence of symptoms after the ingestion of 56 foods or food groups in IBS patients. Overall,

84% of the subjects reported GI symptoms related to at least one of the foods surveyed, with the most cited being dairy products (49%), beans / lentils (36%), apple (28%), wheat flour (24%) and plum (23%). Similar to the described above, of the five foods most consumed by our population (Table 3), four are in common with that found by Böhnstudy: milk, cheese, beans and biscuits, cakes, and breads. On the other hand, some FODMAP rich foods, such as soybean, mushrooms and plums, were not mentioned as they are not usually present in the habitual Brazilian dietary pattern, while in other countries, as in Sweden, plum was highly associated with GI symptoms.

In the study by Ong *et al.*<sup>[12]</sup> (2010), 15 healthy subjects and 15 subjects with IBS were submitted to a diet two day diet either poor (9 g/day) or rich in FODMAPs (50 g/day). GI symptoms were assessed using hedonic scale. Patients with IBS reported more frequent symptoms such as abdominal pain, bloating, and flatulence with FODMAP rich diet, with a median of 6 points. However, even in healthy subjects the FODMAP rich diet also resulted in higher scores when compared to the low FODMAP diet, with medians of 3 and 1, respectively. The most reported symptom in this group was flatulence, as observed in the present study.

Halmos *et al.*<sup>[13]</sup> (2014) performed a cross-over study with 30 patients with IBS and 8 healthy subjects, who received a low FODMAP diet (less than 0.5 g of FODMAPs per meal) or a typical Australian diet. Daily symptoms were assessed using a visual analog scale from 0 to 100. IBS patients had significantly lower gastrointestinal scores (median of 22.8) while on the low FODMAP diet compared to the Australian diet (median of 44.9). Swelling, pain, and gas release were also reduced. In healthy subjects there were no significant changes in symptoms in both the FODMAP poor diet and the Australian diet.

Although Halmos study did not find significant differences in the healthy population, Australian dietary pattern may not typically present foods rich in FODMAPs, with little difference in relation to the restricted diet. When comparing to the Brazilian diet, for example, where we have the cultural tradition of consumption legumes, rich in oligosaccharides, regularly, we found a higher frequency of complaints such as flatulence and stomach noises in healthy individuals.

In a recent systematic review, adherence to a low FODMAP diet was shown to be significantly associated with the reduction of symptoms such as abdominal pain, abdominal distension and gastrointestinal symptoms in general<sup>[14]</sup>. Maagaard *et al.*<sup>[1]</sup> (2016) investigated the adherence to this diet and its relation with disease evolution. Of the 180 patients evaluated, 150 (86%) presented partial or complete adherence to dietary treatment. As FODMAPs are distributed in different food groups (dairy, cereals, fruits, etc.), but not necessarily present in all foods in a same group (for example, a higher concentration in plums and peaches but not in apples) it may provide greater flexibility in food consumption, being less restrictive.

Even in individuals with no diagnosis of IBS, as showed here, regular consumption of these foods may be associated with a high incidence of flatulence, the most frequently reported symptom. Although most studies in literature included individuals with IBS or IBD, where there are functional alterations of the intestinal mucosa, resulting more intense symptoms, we can assume that variable distresses can be induced in healthy individuals, even if in milder proportions. Thus, identifying the main FODMAPs rich foods within a particular dietary habit is important for necessary adaptations of guidelines and/or food lists to be used in both IBS and healthy subjects for improvement of GI symptoms.

**Table 1** Participants Characteristics.

Age/ Gender	Woman (n = 110)	Men (n = 24)	Total (n = 134)
Until 19 years	0.0 % (n = 0)	4.2 % (n = 1)	0.70 % (n = 1)
20 - 29 years	49.01 % (n = 54)	37.5 % (n = 9)	47.0 % (n = 63)
30 - 49 years	40.9 % (n = 45)	33.3 % (n = 8)	39.6 % (n = 53)
50 - 75 years	10.0 % (n = 11)	25.0 % (n = 6)	12.7 % (n = 17)

**Table 2** Frequency of different stool consistencies and bowel ovements reported by participants.

Stool consistency	
Types 1 - 2	23.10%
Type 3 - 4	69.40%
Type 5 - 6 - 7	7.50%
Bowel Movements	
More than 3 stools/day	2.30%
Daily	67.90%
Alternate days	21.60%
Less than 3 bowel movements/week	6.70%
Alternation between diarrhea and constipation	1.50%

**Table 3** Gastrointestinal symptoms frequency reported by participants.

Scale / Symptoms	0	1	2	3	4
Abdominal pain	66.40%	23.10%	7.50%	3.00%	0.00%
Abdominal distension	48.50%	28.30%	12.70%	6.00%	4.50%
Abdominal discomfort	35.80%	38.80%	17,9 %	4.50%	3.00%
Flatulence	11.20%	38.10%	32.00%	7.50%	11.20%
Intestinal or stomach sounds	25.40%	35.00%	20.90%	7.50%	11.20%

Where 0 = never; 1 = once a week; 2 = 2 to 3 times per week; 3 = 4 to 6 times per week; 4 = every day of the week.

**Table 4** FODMAP rich foods consumed by participants.

	Most consumed (at least 1x a day)	Least consumed (Never)
1º	Onion and / or garlic	Soy
2º	Biscuits, cakes and breads	Sweeteners of the type: xylitol, sorbitol or mannitol
3º	Cheese (cottage, ricotta, cream cheese)	Fresh Mushrooms
4º	Milk (cow, goat, sheep, etc.)	Peach or nectarine
5º	Legumes	Plum

## CONCLUSION

Gastrointestinal symptoms were present in this healthy population with flatulence and stomach noises being the most frequent. The increased consumption of FODMAP rich foods, which constitutes the Brazilian dietary pattern, such as onions and/or garlic, biscuits, cakes and breads based on wheat flour, cheese, milk and legumes) may contribute to the symptoms reported. It is suggested, therefore, that even in the absence of IBS or other intestinal disease, the decrease in FODMAP rich foods intake may contribute to improve these symptoms.

## ACKNOWLEDGMENTS

Research involving Human Participants: All procedures performed in studies involving animals were in accordance with the ethical standards of the institution or practice at which the studies were conducted. The research protocol was approved by the Ethical Committee of the University Hospital Clementino Fraga Filho of the Universidade Federal do Rio de Janeiro under the CAAE number 68575517.4.0000.5257.

Informed consent: Informed consent was obtained from all individual participants included in the study.

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