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ORIGINAL ARTICLE

Self-reported food intolerances in an Indian population: Need for individualization rather than a universal low-FODMAP diet

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Abstract

Background and Aim: Low-fermentable oligo-, di-, and monosaccharides and polyol (FODMAP) diets have been recommended for individuals with food intolerance and irritable bowel syndrome (IBS). Individual food intolerances may, however, not correspond to the FODMAP content alone.
Methods: We conducted a survey on self-reported intolerance to articles of food commonly identified as high FODMAP in 400 healthy Indian subjects (median age 40 years; 69% men) and 204 consecutive consenting patients with IBS (median age 36 years; 58% men).
Results: One-hundred seventy-nine (44.8%) healthy subjects and 147 (72.1%) patients with IBS reported some food intolerance ($P < 0.00001$); the latter reported intolerance to all items (except nuts) more frequently than healthy subjects. The prevalence, however, varied from 2.5 to 32%. Milk intolerance was reported equally commonly by healthy subjects and patients (23% *vs* 29.9%). Twenty-three (11.3%) patients and no healthy subjects reported wheat sensitivity. The IBS diarrhea subgroup reported intolerance to milk, pulses, capsicum, cauliflower, leafy vegetables, and dry fruits more frequently than the constipation subgroup.
Conclusion: From among a list of high-FODMAP items, individuals' intolerance varied widely, suggesting that individuals should be the final judge in deciding their elimination diets rather than devise them based on the FODMAP content alone. As in the West, food intolerance was reported more commonly by patients with IBS, especially those with diarrhea, than by healthy individuals. Also noteworthy is the low prevalence of milk intolerance in a subcontinent labeled as high in lactose intolerance. Unlike in the West, wheat intolerance was not reported by any healthy individual.
Individual food intolerances may not correspond to the fermentable oligo-, di-, and monosaccharides and polyol (FODMAP) content alone. From among a list of high-FODMAP items, individuals' intolerance varied widely, suggesting that individuals should be the final judge in deciding their elimination diets rather than devise them based on FODMAP content alone.

Introduction

Food intolerance, estimated to affect about 20% of the world population,[1] has been defined as a non-immunological response (unlike food allergy) initiated by a food or its component at a dose normally tolerated.[2] The global market for food intolerance products was estimated to reach USD14 billion by 2022, with diabetic, gluten-free, and lactose-free products leading the list (Food Intolerance Products Market, Food Allergy Market 2022; alliedmarketresearch.com). Food intolerance also plays a significant role in the symptomatology of irritable bowel syndrome (IBS); more than 60% of patients report the onset or worsening of symptoms after meals.[3] Most patients (84%) report symptoms related to at least one food item, associated with higher symptom severity scores and reduced quality of life.[4]

Fermentable oligo-, di-, and monosaccharides and polyols (FODMAPs)—a group of poorly absorbed short-chain carbohydrates, including lactose and fructose in excess of glucose, fructans, galacto-oligosaccharides, and polyols or sugar alcohols—along with gluten have been most commonly incriminated in food intolerance in the West.[5] While advice on elimination diets should focus on the individual's intolerances, as is often done in health-advisory websites, a diet low in FODMAPs and gluten is prescribed as the first step in many clinical studies. Admittedly, this does relieve symptoms in populations with IBS, as several recent meta-analyses have shown,[6–9] but concerns have been raised about the evidence[10] and such a diet may not cater to individual needs.

Several studies from the West have analyzed the content in FODMAPs of foods commonly consumed there.[11,12]

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Varney *et al.*[13] have devised an app that enables the use of these data for developing low-FODMAP diets around the world. Many of the items analyzed, however, are processed foods, ready-to-eat items, or foods not commonly consumed in Asia outside of the more Westernized Pacific Rim.[14] The authors mention that the preparation method or processing can affect the FODMAP content, which may explain why there is limited information on the FODMAP content of foods commonly consumed in the Indian subcontinent.[15]

A recent study highlighted the difficulty in devising low-FODMAP diets for an Indian population with heterogeneous dietary practices.[16] We believe that this difficulty is partly due to devising food lists based on the FODMAP content of articles for populations with diverse cuisines. Our contention is that, when devising elimination diets, individual intolerances, and not only the FODMAP content, need to be given priority since they vary widely, although to a large extent they correspond to the FODMAP content.

There are data available on lactose intolerance from the Indian subcontinent.[17] We have recently reported our data on self-reported wheat sensitivity among healthy Indian subjects and patients with IBS.[18] In rural northern India, vegetarianism has been reported as a risk factor for IBS symptoms, possibly related to the high content of FODMAPs, including milk products, in the vegetarian diet.[19]

Having said that, some key features about the diversity of Indian cuisine need mention. Although there are similarities within the subcontinent (and within South Asia) that are different from other regions of the world, there is no such thing as one traditional Indian diet. The subcontinent is heterogeneous, with multiple religions, ethnicities, and descents, and food habits vary remarkably. About a third of the Indian population, for example, identifies itself as vegetarian (a term that includes lacto-vegetarians), making it the world's largest vegetarian population (https://www.statista.com/statistics/1280079/global-country-ranking-vegetarian-share/). The predominant cereal grown and consumed is wheat in northern India and rice in southern and eastern India. The vegetables consumed vary with the region and season. Milk and dairy products are popular in states such as the Punjab, and fish is popular in the coastal states. Livestock consumption is largely influenced by religious beliefs. Nuts and fruits have regional distribution and, in general, are not easily affordable. The famous "Indian" spices and condiments are available everywhere in the subcontinent, but consumption varies with the region. There is wide variation in the way food is processed or prepared even in regions where the articles consumed are similar.

On a background such as this, it is not possible to draw conclusions on intolerances to food preparations/dishes that are universal truths for the region. The city of Mumbai is India's most populous and cosmopolitan; over 40% of its population are migrants from other states or, less commonly, from within the state of Maharashtra (this is what the census data show about migrations to Mumbai; www.indianexpress.com). This city is therefore considered a microcosm of India, and a study of dietary habits and food intolerances from here is as close a representation as can be of the whole of India.

We conducted this survey on self-reported intolerance to frequently consumed articles of food in the Indian diet to determine whether they reflect the FODMAP content of the articles or show individual variability.

Material and methods

These data were extracted from the annex to a pro forma designed for a prospective observational survey to determine the prevalence of self-reported wheat sensitivity in a normal population and a cohort of patients with IBS.[18] A total of 400 healthy subjects obtained by convenience sampling and 204 consecutive consenting patients with IBS participated in the survey.

The pro forma had a list of articles of food (milk, vegetables, fruit, nuts, condiments) generally considered to be high-FODMAP items and commonly used in the diet in the Indian subcontinent; participating subjects had to tick it in a yes/no format. Items not specifically included could be listed by the participating subjects in the section "Others." The pro forma was initially evaluated in a group of other respondents for ease of completion; one author (PD) then sat with each of the subjects participating in the study to provide translations into local languages when needed and clarify doubts.

This study was conducted according to the guidelines laid down in the Declaration of Helsinki, and the protocol was approved by the Institutional Review Board (Project No. 1026-16-PA), which is registered with the Department of Health Research, Government of India. Written informed consent was obtained from all participating subjects.

Statistical methods. Proportions were compared using the chi-square test with Yates' correction (www.socscistatistics.com) or Fisher's exact test (www.statology.org), as appropriate.

Results

The 400 healthy subjects included 276 men (69%; median age of subjects 40 years, IQR = 16); the 204 IBS patients included 119 men (58%; median age of patients 36 years, IQR = 17). The number of IBS patients with diarrhea, constipation, and mixed variety was 82, 62, and 60, respectively; there was no difference in the proportion of males and females between the subtypes of IBS.

One-hundred seventy-nine (44.8%) healthy subjects and 147 (72.1%) patients with IBS reported some food intolerance (P <0.00001); the list of items incriminated varied between individuals, and the prevalence of intolerance varied from 2.5 to 32%. The IBS group reported intolerance to all items (except milk and nuts) more frequently than the healthy subjects (Table 1). Milk intolerance was reported equally commonly by the healthy subjects and patients with IBS (23% *vs* 29.9%; P = 0.07). Twenty-three (11.3%) patients with IBS, and none of the healthy subjects, reported wheat sensitivity. Between the symptom subgroups of IBS patients, the diarrhea subgroup self-reported intolerance to milk, pulses, capsicum, cauliflower, leafy vegetables, and dry fruits more frequently than the constipation subgroup (Table 2).

Discussion

We report, for the first time from the Indian subcontinent, self-reported food intolerances in healthy individuals and patients

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Table 1 Self-reported intolerance to various food items by healthy subjects and patients with irritable bowel syndrome (IBS)

	IBS				*P*-value	
Food items	Total $n = 204$	Non-wheat-sensitive (NWS) $n = 181$	Wheat-sensitive (WS) $n = 23$	Healthy subjects $n = 400$	IBS *vs* Healthy	WS *vs* NWS
Milk	61 (29.9%)	61 (33.7%)	None	92 (23%)	0.07	0.0002
Pulses	65 (31.9%)	59 (32.6%)	06 (26.1%)	48 (12%)	0.00001	0.53
Onion	17 (8.3%)	13 (7.2%)	04 (17.4%)	06 (1.5%)	0.0001	0.95
Garlic	27 (13.2%)	23 (12.7%)	04 (17.4%)	01 (0.3%)	0.00001	0.53
Capsicum	32 (15.7%)	27 (14.9%)	05 (21.7%)	02 (0.5%)	0.00001	0.4
Peas/beans	19 (9.3%)	13 (7.2%)	06 (26.1%)	09 (2.3%)	0.0003	0.003
Cabbage	14 (6.9%)	12 (6.6%)	02 (8.7%)	08 (2%)	0.005	0.71
Cauliflower	32 (15.7%)	29 (16%)	03 (13%)	05 (1.3%)	0.00001	0.71
Leafy vegetables	55 (27%)	53 (29.3%)	02 (8.7%)	07 (1.8%)	0.00001	0.04
Dry fruits	26 (12.7%)	19 (10.5%)	07 (30.4%)	18 (4.5%)	0.0004	0.007
Nuts	05 (2.5%)	None	05 (21.7%)	07 (1.8%)	0.55	0.00002
Fruits	23 (11.3%)	21 (11.6%)	02 (8.7%)	17 (4.3%)	0.002	0.68
Fresh juices	14 (6.9%)	13 (7.2%)	01 (4.3%)	03 (0.8%)	0.00002	0.61
Others	07 (3.4%)	06 (3.3%)	01 (4.3%)	05 (1.3%)	0.12	0.8

with IBS. Our study showed wide variation in the food intolerances reported, although the items listed in the pro forma are generally considered high in FODMAPs.

Other interesting findings were the low prevalence of milk intolerance in our healthy and IBS populations, the low prevalence of wheat sensitivity (absent in the surveyed healthy population), and differences in the food intolerance between IBS patients who self-report as wheat-sensitive and non-wheat-sensitive. As expected, patients with IBS more often reported food intolerances than the healthy population, and the IBS-diarrhea subgroup more often than the IBS-constipation subgroup. These findings are similar to those reported elsewhere, most studies being from the Western world.[4]

These facts are important because elimination diets generally focus on FODMAPs and gluten content. By this criterion, an elimination diet in India would restrict milk and other high-FODMAP items and wheat products. A majority of our surveyed population would, however, tolerate these items. A recent study highlighted the difficulty in identifying a low-FODMAP diet that would be acceptable as elimination diet to all regions in India.[16] Our contention is that elimination diets based on reported FODMAP content cannot be applied indiscriminately to individuals, let alone populations; instead, such diets should be based on individual intolerances.

Intestinal lactase activity is high in northern Europe, whereas Asia and much of Africa are rated as low-persistence regions.[20] The Indian subcontinent is listed as a region where over 60% of the population is lactase deficient/lactose intolerant (lactose intolerance; www.medlineplus.gov). However, milk consumption has increased dramatically in India after the famous

Table 2 Self-reported intolerance to various food items by the symptom subgroups of patients with irritable bowel syndrome (IBS)

	IBS				*P*-value
Food items	Total $n = 204$	IBS-d $n = 82$	IBS-c $n = 62$	IBS-m $n = 60$	IBS-d *vs* IBS-c
Milk	61 (30%)	43 (52.4%)	03 (4.8%)	15 (25%)	0.00001
Pulses	65 (31.9%)	42 (51.2%)	06 (9.7%)	17 (28.3%)	0.00001
Onion	17 (8.3%)	09 (11%)	03 (4.8%)	05 (8.3%)	0.2
Garlic	27 (13.2%)	14 (17.1%)	05 (8.1%)	08 (13.3%)	0.14
Capsicum	32 (15.7%)	15 (18.3%)	04 (6.5%)	13 (21.7%)	0.05
Peas/beans	19 (9.3%)	10 (12.2%)	03 (4.8%)	06 (10%)	0.2
Cabbage	14 (6.9%)	08 (9.8%)	02 (3.2%)	04 (6.7%)	0.2
Cauliflower	32 (15.7%)	20 (24.4%)	05 (8.1%)	07 (11.7%)	0.01
Leafy vegetables	55 (27%)	41 (50%)	None	14 (23.3%)	0.00001
Dry fruits	26 (12.7%)	16 (19.5%)	01 (1.6%)	09 (15%)	0.001
Nuts	05 (2.5%)	03 (3.7%)	01 (1.6%)	01 (1.7%)	0.6
Fruits	23 (11.3%)	11 (13.4%)	06 (9.7%)	06 (10%)	0.6
Fresh juices	14 (6.9%)	05 (6.1%)	05 (8.1%)	04 (6.7%)	0.7
Others	07 (3.4%)	06 (7.3%)	None	01 (1.7%)	0.04

IBS-c, irritable bowel syndrome constipation-predominant; IBS-d, irritable bowel syndrome diarrhea-predominant; IBS-m, irritable bowel syndrome mixed.

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"white revolution" of the 1970s. The close to 80 million metric tons of cow milk consumed annually makes India the highest consumer in the world (global consumption of milk per year by country, 2020; www.statista.com).

Our finding of no self-reported wheat sensitivity in the general population is also noteworthy; reported prevalence from Western countries is up to 10% or more.[21] One contributing factor may be that, unlike in the West, this condition has not received wide media attention and awareness here. We have no ready explanation for the differences in tolerance reported by the wheat-sensitive and non-wheat-sensitive IBS patients. Surprisingly, none of the former group reported milk intolerance. Dry fruits in general and nuts such as cashew nuts and pistachios are high-FODMAP items, so it is not surprising that the wheat-sensitive IBS patients more often reported intolerance to these.

A recent study from Korea mentioned a high prevalence of self-reported food intolerance in patients with IBS[22]; this study highlighted the need to identify region-specific food intolerances. The Korean study listed foods or dishes (such as whole milk, instant ramen, noodles, pizzas, and hamburgers) causing gut symptoms. Our study differed in that we looked not at food preparations but at articles/ingredients/components of food that trigger symptoms. This is especially relevant for a subcontinent where these articles are used in various proportions and preparations in the wide variety that goes under the label "Indian cuisine." There is wide variation in the way food is processed or prepared even in regions where the articles consumed are similar.

The emphasis on low-FODMAP diets as elimination diets particularly in patients with IBS, the problem with devising and implementing these diets in culturally diverse regions, the lack of knowledge of FODMAP contents in many non-Western food items, and suggested approaches to overcome these problems using staged interventions have been detailed in a recent review from Australia.[23] Our study offers an alternative approach to elimination diets.

One problem with food intolerance is its definition, being defined as intolerant to doses that are "normally tolerated." The latter is subjective. The threshold for self-defined food intolerance varies. Where objective tests are available, as in lactose intolerance, the correlation with real life is questionable. Thus, the Indian population is listed as lactase-deficient/lactose-intolerant, but the data are extrapolated from laboratory tests. In our study, less than one-quarter of healthy individuals and one-third of patients with IBS considered themselves milk-intolerant. The national milk consumption figures also seem to bear this out.

The strength of this study is that it identifies articles of food rather than processed or prepared dishes, which have wide regional variations in the Indian subcontinent. Secondly, this is a list of self-reported intolerances, rather than one based on content of FODMAPs or gluten. An important message that emerges from this study is that, among those who reported intolerance, the items incriminated showed wide individual variation. This point needs to be considered when prescribing diets; while a chart of low-FODMAP foods is a guide, each individual's need is different. A limitation of our study is that we have not identified the nutritional component of the offending items. Also, we have not validated our suggestions in an interventional study.

In conclusion, we have listed common food articles that have been identified as cause of food intolerance by a cohort of healthy individuals and patients with IBS from the Indian subcontinent. As expected, the latter group more commonly identified offending items, more so in the diarrhea subgroup. Considering the wide variability of reported individual intolerances even among the high-FODMAP items we studied, we believe that devising elimination diets, hitherto with emphasis on FODMAP contents, should instead include inputs (items and quantity) from the affected individual as the starting point rather than follow fixed lists based on FODMAP or gluten contents. Such an approach can help overcome difficulties in devising elimination diets. The affected individual, and not the doctor, should be the final judge.

Data availability statement. The source data are stored in the department records and will be made available on reasonable request.

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