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Is Fructose Malabsorption a Cause of Irritable Bowel Syndrome?

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Abstract

Irritable Bowel Syndrome (IBS) is a condition that may be marked by abdominal pain, bloating, fullness, indigestion, belching, constipation and/or diarrhea. IBS symptoms can result from malabsorption of fructose. Fructose is a monosaccharide found naturally in small quantities in fruits and some vegetables, and in much larger quantities in industrially manufactured sweeteners and a dded sugars (e.g. sucrose and high fructose corn syrup). Fructose malabsorption leads to osmotic diarrhea as well as gas and bloating due to fermentation in the colon. A low-fructose diet has been found to improve IBS symptoms in some patients. This paper discusses the prevalence of fructose malabsorption and considers fructose ingestion as a possible cause of, and possible dietary treatment strategy for, IBS.

Keywords

diarrhea; fructose; gastrointestinal; irritable bowel syndrome; sugar; high fructose corn syrup

Introduction

Irritable Bowel Syndrome (IBS) is a condition marked by abdominal pain, bloating, fullness, indigestion, belching, constipation and/or diarrhea. The cause of IBS is not definitively known although sensitivities to certain foods produce many symptoms consistent with the disorder. True food allergies are relatively uncommon in patients with IBS,(1) yet fructose malabsorption occurs frequently in IBS patients.(2) Poorly absorbed fructose can exacerbate

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and contribute to IBS symptoms and restricting fructose in the diet can lead to symptom improvement. This brief report explores some of the evidence for the link between fructose malabsorption and IBS.

Fructose Malabsorption May Cause Irritable Bowel Syndrome

From a physiologic standpoint, the human intestine lacks enzymes to digest and transport fructose.(1) The absorption of fructose occurs mainly via a non-specific glucose transporter (GLUT 2) and this transporter can be overwhelmed by small fructose loads.(1, 3-5) Some healthy individuals' capacity to absorb isolated fructose might be as little as 5 grams,(6) with fructose malabsorption (determined by hydrogen breath analysis) occurring at this level.(7) Bigger loads of fructose reduce the absorptive capacity in a dose-dependent way. In one experiment, ingestion of 5 or 10 grams of fructose lead to 10% of the study group being diagnosed as fructose malabsorbers, which increased to 40% when 20 grams of fructose was ingested.(3) Another study found malabsorption of fructose starting at higher doses (around 37.5 grams or higher).(8) In a randomized, double-blind, dose-response study, healthy individuals were able to tolerate 25 grams of fructose but when 50 grams of fructose was administered, 80% of patients exhibited malabsorption (based on breath tests measuring hydrogen and methane) with approximately 50% of subjects reporting mild to moderate belching, bloating or diarrhea.[5] Another study showed that almost 40% of patients exhibited fructose malabsorption at an intake of 25 grams, and 66% of patients at an intake of 50 grams.(9)

Unabsorbed fructose may lead to an osmotic effect by increasing the liquidity of intestinal contents and increasing gastrointestinal motility.(1) Additionally, unabsorbed fructose can lead to the production of short chain fatty acids, hydrogen, carbon dioxide and trace gases from its fermentation by bacteria that reside in the colon. The increased production of gases can cause gastrointestinal side effects that mimic IBS.(1, 3, 4, 6, 10) Other possible mechanisms of fructose-induced gastrointestinal symptoms could include local ‘irritating’ effects of fructose upon contact with the intestinal tract. Yudkin indicated that after eating sugar, patient's intestine's become irritated and red.(11)

Acute feeding studies have shown that almost one-third of patients with IBS are unable to tolerate large amounts of fructose, whereas patients without IBS do not have this issue. (1), (12-15) In patients who have a positive hydrogen breath test (i.e. a rise in breath hydrogen or methane indicating fructose malabsorption/fermentation in the intestine), 75% have their principal symptoms at the time of breath test positivity.(5) Data are somewhat conflicting in regards to if patients with functional gastrointestinal disorders (i.e. IBS) have a greater likelihood of also being fructose malabsorbers (40-80% prevalence) as compared to healthy individuals (11-70%).[5] An uncontrolled study showed that the prevalence of incomplete fructose absorption (at 25g) is higher in patients with functional bowel disorders (36-75%) versus healthy subjects (0-50%).(6) While it is not known for certain if gastrointestinal disorders can cause fructose malabsorption (although it is possible that if intestinal glucose transporters are injured this would then affect fructose absorption), it seems highly probable that fructose malabsorption can lead to gastrointestinal symptoms.

The studies referenced above tested isolated fructose. Such studies may overestimate the prevalence of fructose malabsorption, as fructose is almost always consumed together with glucose in both naturally occurring and processed foods.(1) Indeed, when patients ingested 40 g of high fructose corn syrup (HFCS)-55, the prevalence of fructose intolerance (defined as having both an abnormal breath test and symptoms) was just 7%.(6) Yet, when pure fructose was consumed, the prevalence increased to a prevalence of 40% (p-value for the difference in prevalence between HFCS-55 and pure fructose = 0.062).(6) Despite a somewhat low prevalence of 'fructose intolerance' (when both gastrointestinal symptoms and a positive hydrogen breath test are used as the definition) 10% of healthy individuals and 47% of patients with IBS have 1 or more symptoms upon ingestion of HFCS-55 (providing 40 grams of fructose). Moreover, when ingesting 40 grams of fructose (provided as HFCS-55), 20% of healthy individuals and 30% of IBS patients were shown to have fructose malabsorption (based on an abnormal hydrogen breath test). Thus, randomized data indicate that around 1 in 2 patients with IBS have an exacerbation of gastrointestinal symptoms if they ingest 40 grams of fructose (when obtained from ingestion of HFCS-55). This level of fructose can be obtained by ingesting approximately two 12 oz. cans of regular soda. The prevalence of fructose malabsorption would presumably be higher if HFCS-90 (90% fructose; e.g., occurring in many agave products) were used as the sugar source instead as fructose malabsorption is both dose and concentration dependent.

Just as fructose loads may cause or exacerbate symptoms associated with IBS, dietary restriction of fructose may improve symptoms. In one study in patients with IBS and fructose malabsorption, 74% of individuals had improvements in all abdominal symptoms when avoiding fructose in the diet (e.g., fruits with a fructose concentration higher than glucose, certain dried fruits, fruit juice, high fructose corn syrup, sucrose, honey, etc.).(12) Additionally, overall positive response was significantly better in those adherent versus non-adherent to the diet (85% vs. 36%; $P<0.01$), including improvement in individual symptoms ($P<0.01$ for all symptoms). The authors concluded that, "fructose malabsorption dietary therapy achieves a high level of sustained adherence and good symptomatic response." Other studies show similar symptoms improvement with fructose restriction.(10),(12, 16) Importantly, others(5, 7, 8, 17) suggest that fructose malabsorption is dose-dependent as well as concentration dependent.

Fructose is not consumed in isolation in the diets of free-living individuals though, and more general carbohydrate restriction has been shown to be beneficial for symptoms relief. Two-thirds of patients with abdominal bloating and gas-related symptoms (72.2% with sugar malabsorption—i.e. malabsorption of lactose, fructose plus sorbitol, or both [lactose and fructose + sorbitol), had clinical improvement out to 12 months (i.e. complete improvement in 50% and partial improvement in 16.7%) when educated about dietary restriction of these substances.(18) A randomized trial indicated that more than three-quarters of diarrhea-predominant IBS patients derived adequate relief of symptoms (stool frequency decreased, stool consistency improved from diarrheal to normal form, and pain scores and quality-of-life measures significantly improved) when placed on a very low carbohydrate diet.(19) In another trial, a marked improvement in symptoms in over 50% of patients (with either IBS or nonspecific functional bowel complaints) was shown upon restriction of either lactose, fructose, or sorbitol for 1 month.(20) The authors concluded that, "dietary restriction of the

offending sugar(s) should be implemented before the institution of drug therapy." This trial also showed that only 7% of IBS and 8% of patients with functional bowel complaints absorbed all three sugars normally (e.g. the frequency of sugar malabsorption among patients in both groups was 78% for lactose, 44% for fructose, and 73% for a mixture of fructose + sorbitol).

The absorption of fructose is more efficient when combined with glucose.(21) Fructose loads from whole foods with mixed carbohydrates, like fruits and vegetables, might be expected to cause little problem with regard to malabsorption (except for perhaps fruits with a higher fructose concentration versus glucose, such as honeydew, star fruit, pear, pawpaw/papaya, mango, guava, watermelon, and apple to name a few). But refined products that are particularly high in fructose relative to glucose (such as HFCS-90 or agave, in which fructose has been found to make up 84.29% of the carbohydrate content(22)) may particularly pose problems for patients with IBS.

Implications

Encouraging patients to choose whole foods (e.g., vegetables, grains, nuts, and a selection of fruits as tolerated) and avoid highly-processed foods (e.g., sodas and industrially produced baked goods full of fructose-predominant added sugars), might lead to decided benefit and symptom control in patients with IBS.

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Abbreviations

HFCS	high fructose corn syrup
IBS	irritable bowel syndrome