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Use of dietary interventions for functional gastrointestinal disorders

Lauren P Manning and Jessica R Biesiekierski

The role of food in the development of symptoms experienced within functional gastrointestinal disorders (FGIDs) is well recognised. This review aims to describe the evidence base for dietary interventions in the different functional esophageal, duodenal and bowel disorders. Randomised controlled trials are lacking for many of the FGIDs, with the exception of irritable bowel syndrome (IBS). Restricting rapidly fermentable, short-chain carbohydrates (FODMAPs) provides an evidence based dietary approach for the management of symptoms of IBS. Recent evidence shows the upper GI motility response varies between carbohydrates, which gives promise for the potential application of the low FODMAP diet in upper GI disorders. In addition to fine-tuning our FODMAP understanding, other observational data and smaller sized studies create an exciting and optimistic future for dietary management of all FGIDs.

Address
Department of Rehabilitation, Nutrition and Sport, La Trobe University, Melbourne, Australia

Corresponding author: Biesiekierski, Jessica R (j.biesiekierski@latrobe.edu.au)

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Introduction

Functional gastrointestinal disorders (FGIDs) encompass a collection of symptoms in the absence of organic disease and motility disorders, recognised by symptom reporting and diagnosed following the Rome criteria [1]. FGIDs have been classified throughout the GI tract and are identified as disorders of gut-brain interaction largely pertaining to visceral hypersensitivity, altered central nervous system processing, motility disturbance, altered gut microbiota, and altered mucosal and immune function [2]. Given the heterogeneity and incomplete understanding of these factors underlying symptom generation, few effective treatment alternatives to the use of drugs as add-on therapy are currently available. Patients with FGID often self-report food related GI symptoms [3], leading them to instituting dietary changes potentially to an extent that may compromise nutrition. Despite self-diagnosis, only 11–27% of patients can accurately identify their presumed offending food when re-challenged in a double-blind manner [4]. Dietary interventions do offer an independent self-management approach for patients with FGIDs, however food is complex and the evidence is limited by challenges associated with the design and reporting in dietary intervention trials [5•].

Therefore, this review aims to give an overview of the data supporting the use of dietary interventions in FGIDs in adults including both observational and clinical trial data. A literature search was conducted using the Medline, Cinahl and Embase databases using phrases such as 'functional gastrointestinal disorders', 'diet', 'nutrition', 'food', 'functional bowel disorders' 'functional dyspepsia', 'functional constipation' and 'irritable bowel syndrome'. Studies that had a clinical trial design or were observational were included. The following summarises the levels of literature including gaps in knowledge and recent developments in understanding dietary triggers and intervention in FGIDs sub-sectioned into three categories; esophageal, gastroduodenal and bowel disorders.

Esophageal disorders

Functional heartburn (FH) is characterised by retrosternal burning, discomfort or pain. It occurs in the absence of structural, motor and mucosal abnormalities as well as gastroesophageal reflux disease (GERD). The functional nature of this condition is based on the non-responsiveness to acid suppressive therapies, a lack of symptom-reflux correlation and little conclusive evidence for GERD [6]. Lifestyle changes are often advocated for, such as reducing overweight and obesity. Other changes often recommended include reducing intake of fatty foods, spicy foods, fizzy drinks and decreasing meal size and late meals. These therapeutic strategies have little evidence to support them. Patients with FH should be provided with reassurance of the harmless effects of many foods and encouraged to avoid restrictive diets [7,8].

Transient lower esophageal sphincter relaxations (TLESRs) are relaxations of the lower esophageal sphincter (LES) that are not triggered by swallowing and allow reflux of ingested air and gas during belching [9]. They occur mainly postprandially and are triggered by gastric distension, which activates mechanoreceptors in the proximal stomach and a vago-vagal pathway resulting in

release of nitric oxide at the LES [9]. Meal challenge tests have shown an increase of TLESRs in GERD patients [10]. In one small study, fructans (the carbohydrate found in wheat, rye, onion and garlic) were shown to increase gastro-esophageal reflux [11], additionally less gastric accommodation was associated with a higher rate of reflux events [12]. Further exploration is required to understand how fructans influence these effects, whether they may influence gastro-esophageal crosstalk and importantly, whether these effects extend to reflux hypersensitivity and the other functional esophageal disorders. Overall, there is minimal quality evidence investigating the relationship between meal ingestion and the upper gastric sensorimotor dysfunction and epigastric symptoms related to esophageal disorders.

Gastroduodenal disorders

Functional dyspepsia

Functional gastroduodenal disorders are classified into four categories of functional dyspepsia (FD), belching disorders, chronic nausea and vomiting disorders, and rumination syndrome [13]. FD is defined as the presence of early satiation, postprandial fullness, epigastric pain or burning, in the absence of underlying organic or metabolic disease [13]. The mechanism is multifactorial including disorders of GI sensorimotor function such as impaired gastric accommodation, hypersensitivity to gastric distension, and delayed gastric emptying [14]. There are many factors to consider in the management of FD, including ingested foods or specific nutrients, where advice of regular meal timing, frequency and smaller sized meals are often recommended [15].

Studies that have investigated diet in FD are mostly observational. The most frequently reported foods via self-completed food frequency questionnaires (FFQ) to aggravate FD include carbonated drinks, sausages, fried food/fatty foods, coffee, alcohol and citrus [16–23]. A cross-sectional study looking at the association of symptom alleviating foods in 384 FD participants reported apples, rice, rock candy, bread, seeds, dates, honey, yoghurt, quinces and walnuts to be most commonly associated with their symptoms [20]. Another study assessed 4-month FFQ data, and found the only food consumption frequency and eating habits to be predictors for FD were consumption of canned food and alcoholic drinks [17].

Meal challenge tests consistently show that postprandial symptoms occur in FD [24]. Some studies have assessed dietary interventions in FD, for both causative and treatment intent (shown in Figure 1 with their corresponding level of evidence). Red pepper powder capsules (ground dried fruit of the *Capsicum annuum*, including the seeds) containing 0.7 mg/g capsaicin were administered randomly in 2.5 mg capsule before meals for five weeks [25••]. Compared to the placebo, the red pepper capsules were associated with lower mean overall symptom intensity, epigastric pain, fullness and nausea scores than placebo [25••]. This finding conflicts many of the observational and acute challenge studies where oral intake of capsaicin in capsule form induced dyspeptic symptoms [26,27]. It could be that acute challenges aggravate symptoms and that chronic ingestion reduces FD symptoms. Future studies are needed to evaluate this further, including investigation of the role of chemoreceptor activation of neural pathways by other natural food chemicals in FD symptom induction.

Many observational studies have noted that fatty foods trigger dyspeptic episodes. One intervention study investigated the effects of the macronutrient composition of meals in eight FD patients compared to eight healthy controls. Compared to the control meal and healthy subjects, FD participants displayed greater discomfort, nausea and pain after consuming the high fat meal compared to the high carbohydrate meal [16]. Other studies support this, including both dietary fat restriction [28,29] and symptom induction after dietary fat ingestion [30,31]. Fats may induce dyspeptic symptoms by various mechanisms including hypersensitivity to GI hormones such as cholecystokinin, slowing of gastric emptying, or altering vago-vagal reflex [32].

Another commonly reported trigger food in observational data is wheat products including pasta and bun/bread. One double blind randomised crossover trial [33] assessed the effects of the wheat protein, gluten, in 17 FD after responding to a three week gluten free diet. The gluten challenge was via seven soluble capsules (0.8 g gluten each) daily for seven days and found no significant difference between positive and negative responses to the double blind placebo controlled trial [33]. Most other studies investigating gluten have not been gluten-specific in their findings, given implementation of the gluten-free diet automatically results in substantial reduction fermentable carbohydrates influencing the results.

The effects of the wheat carbohydrate, fructans, on upper GI motility were recently investigated, demonstrating that intragastric administration of fructans leads to rapid onset of GI symptoms (within 30 min), specifically cramps, flatulence and pain in IBS patients [34••]. The study also showed fructans induced higher postprandial gastric pressures compared with glucose. Although this study was conducted in patients with IBS, the results suggest that the proximal small bowel can be an important contributor to fructan-induced symptom generation and that fermentable carbohydrates have strong symptom triggering effects in the upper GI tract, possibly through gastroduodenal and gastro-colonic reflex activities. Duodenal distension has previously been suggested to decrease gastric tone via a vagally mediated enterogastric reflex pathway and that this mechanism is nutrient and