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NUTRITIONAL INFLUENCES ON GUT HEALTH

Alison Burton-Shepherd PGCAP(ed) FHEA R Nutr BSc (Hons) MSc RGN TCH Queens Nurse

'Gut health' is a term that is increasingly used in medical literature and in the food industry. Bischoff (5) argues that it is very difficult to ascertain exactly what gut health is and how it can be measured and goes on to propose that gut health may be defined as 'a state of physical and mental wellbeing in the absence of GI complaints that require the consultation of a doctor, in the absence of indications of or risks for bowel disease and in the absence of confirmed bowel disease.'

The primary function of the gut is to facilitate the uptake of nutrients and the bidirectional passage of ions and water to lubricate the intestinal lumen whilst restricting fluid loss (31). However, according to O'Keefe (33), the colon is recognised to be a metabolic organ in its own right as it contains more bioactive cells than the rest of the body. Moreover, it is well documented that the gut plays a major role in not only modulating immune function (25), but also plays a significant role in maintaining general health and well being, which is summarised in Box 1 (5).

The aim of this article is to consider the mechanisms which are responsible for the optimisation of gut health and to discuss what implications nutrition may have on these mechanisms in the prevention and management of some common gastrointestinal (GI diseases) namely; inflammatory bowel disease (IBD) and irritable bowel syndrome (IBS).

OPTIMISING GUT HEALTH

The two functional entities required to achieve and optimise gut health are the GI barrier and GI microbiome (7).

The intestinal epithelium is a single-cell layer that constitutes the largest and most important barrier against the external environment (21). It acts as a selectively permeable barrier, permitting the absorption of nutrients, electrolytes and water while maintaining an effective defence against intraluminal toxins, antigens and enteric flora (38). The GI microbiome, on the other hand, consists of approximately 10 to the power of 14 bacteria that are mainly located in the large intestine and possess the ability to generate short chain fatty acids (SCFA) from dietary fibre and resistant starch in order to provide energy to the intestinal epithelium (34) and most importantly contributes to the maintenance of gut barrier integrity (5).

There is a growing body of research which indicates a complex inter-relationship between the GI microbiome and the GI barrier (38). It has been hypothesised that defects in the intestinal barrier, leading to increased intestinal permeability, play a significant role in the pathogenesis of several diseases within the GI tract (7). It is thought that disruption of the gut microbiome, termed dysbiosis, is frequently accompanied by overgrowth of pathogenic bacteria or fungi, in conjunction with significant loss of microbial diversity, thus initiating an inflammatory response within the host, which also contributes towards the development of GI and other disease, states (18) as highlighted in Box 1.

Box 1: The intestinal impact on health and wellbeing

- Prevention of malnutrition
- Prevention of allergy
- Prevention of infection
- Modulation of energy homeostasis
- Mood regulation

In light of this aforementioned evidence, it is prudent to suggest that a normal GI microbiota of rich diversity, in conjunction with an intact GI barrier which counteracts the pathogenic bacteria and co-operates with the commensal flora, is required to maintain both gut health and subsequently general wellbeing (5).

Alison Burton-Shepherd is a Nurse Tutor at Florence Nightingale School of Nursing and Midwifery, Kings College University London. She is a Registered Nutritionist lecturing in nutrition and adult nursing with specialist interest in childhood obesity and clinical nutrition.

Box 2: Diseases and disorders associated with human gut microbiome aberration (adapted from ref 18)

- Atopy and asthma
- Candida
- HIV infection
- Coeliac disease
- Type 1 and II diabetes
- Gastroenteritis
- Inflammatory bowel disease
- Irritable bowel syndrome
- Obesity
- Rheumatoid arthritis

INFLAMMATORY BOWEL DISEASE

Inflammatory bowel disease (IBD), which includes both Crohn's disease (CD) and ulcerative colitis (UC), is a chronic idiopathic inflammatory disorder affecting the GI tract (10). The pathogenesis of IBD is complex and is thought to be attributed to an exaggerated T-cell response directed against environmental factors and/or a subset of commensal flora/pathogens which inhabit the distal ileum and colon of genetically susceptible hosts (30). However, Bien et al (4) argues that despite the fact that the dysbiosis of the gut microbiota is a common feature in patients with IBD, in most cases it cannot be determined whether these changes are casual or merely consequences of the activated immune and inflammatory response. More recently, it has been suggested that impaired microbiota enzymatic activity observed in IBD-associated dysbiosis leads to deleterious modifications in the luminal Bile Acid (BA) pool composition, which may participate in the chronic inflammatory process observed in IBD (13).

IRRITABLE BOWEL SYNDROME

IBS has been described as a functional bowel disorder characterised by abdominal pain, bloating and change in stool output in the absence of an organic cause (43). The sufferers describe colicky abdominal pain accompanied with diarrhoea, constipation or both in an alternating manner (24). The pathogenesis of IBS is obscure and it is unlikely that a single entity is responsible for the diverse presentation of this heterogonous disorder (17). However, recent interest has been directed to the potential role of intestinal microbiota in the pathophysiology and symptom generation of this syndrome (9). Furthermore, recent evidence has also identified that the colonic biota in IBS patients differs significantly from that of healthy individuals due to an imbalance of a number of commensal species belonging to lactobacillus, Bifidobacterium and clostridium groups (28). However, a direct causal link between the microbiota and IBS is not yet identified and, consequently, some authors argue that observed microbial dysbiosis in IBS is circumstantial (41).

Thabane et al (40) would dispute this argument as they assert that it is highly likely that the cause of IBS is as a result of an adverse outcome of an acute infectious gastroenteritis, which more recently has been shown to coexist with dysbiosis, leading to elevated luminal gas production and immune activation observed in IBS patients following an episode of acute gastroenteritis (43).

THE ROLE OF NUTRITION IN MODULATION OF GUT HEALTH AND DISEASE

In order to be able to discuss the role of nutrition in the prevention and treatment of GI disease, initially it is important to characterise the bacterial composition of the human gut in the healthy person.

The gut of the newborn is sterile at birth and bacterial colonisation begins shortly after via the birth canal and or the environmental surroundings with facultative bacteria, such as enterobacteriaceae Enterococcus and streptococcus which are soon followed by anaerobic bacteria including Bacteroides and Bifidobacterium (1). The initial bacterial colonisation after birth and its change according to environment, nursing, weaning and drugs has a critical role in the health and wellbeing of the child (12).

The intestinal flora of an adult is influenced by a plethora of factors including; environmental factors, diet and antimicrobial therapy (37). Diet and nutritional status are amongst the most important modifiable determinants of human health (45). Manipulation of gut microbiota composition and the local production of microbial-derived metabolites by using prebiotics, probiotics and dietary fibres are being explored as a promising avenue of prophylactic and therapeutic intervention improving health outcomes (42). Moreover, so called 'Colonic functional foods' including resistant starch, non starch polysaccharides and oligosaccharides which are fermented by the colonic biota producing short chain fatty acids (SCFA) namely; acetate, propionate and butyrate, provide energy to the colonic epithelial cells and improve mineral absorption and are therefore beneficial for general health (23). Furthermore, butyrate has been shown to possess both anti-inflammatory and anti-carcinogenic potential (16).

NUTRITION AND IBD

As previously discussed, IBD is characterised by chronic mucosal inflammation of the GI tract and can be separated into two different diseases namely UC and CD. The following section will consider the nutritional management of this complaint in 'generic' terms, as it is beyond the scope of this article to consider all the options. Therefore, it is suggested that clinicians involved in treating patients with either UC or CD should also consult the literature to identify any differences in the nutritional management of these two patient groups. Whilst Smith et al (39) propose that dietary intervention to replace any nutritional deficiency is essential and may also be used to treat active disease and to reduce symptoms, Yamamoto (46) argues that the role of dietary interventions and enteral nutrition in the management of IBD remains unelucidated.

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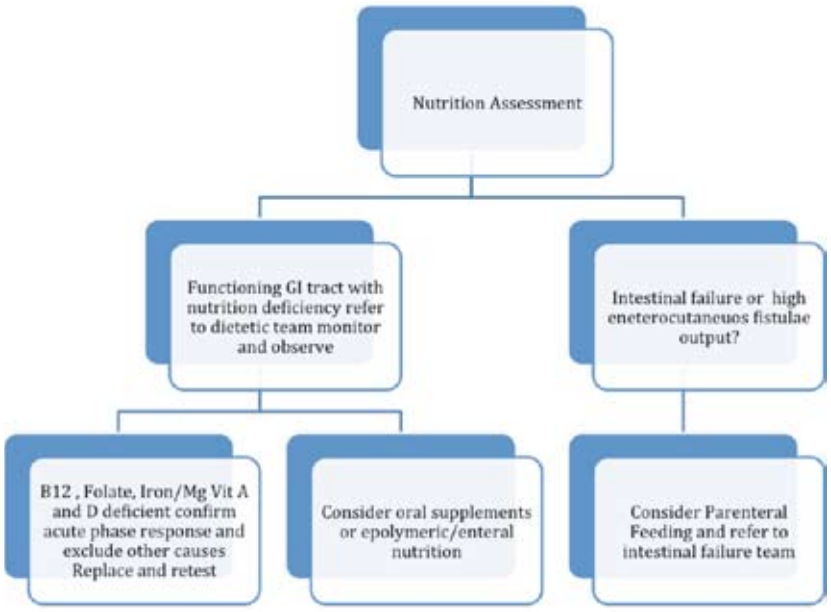
Love Your Gut (Gut Week) is a public health awareness campaign from Core and the IBS Network in association with Yakult UK Limited. Neither Core nor the IBS Network endorses any specific commercial or pharmaceutical products. For full terms and conditions please visit www.loveyourgut.com/HCP

Figure 1: Nutritional intervention in inflammatory bowel disease (adapted from ref 39)



Given that the pathogenesis of IBD involves aberrations in the gut microbiome which may perpetuate the inflammation seen in this disease (27), it is prudent to suggest that, as both prebiotics and probiotics beneficially modulate and affect the GI microbiota, they may have potential therapeutic benefit in the management of IBD (11). However, in a recent review, Leone et al (26) asserts that, although the use of probiotics, prebiotics and/or dietary alterations are all intriguing complementary therapeutic approaches to alleviate IBD symptoms, the interactions are complex and it is unlikely that a one-size-fits-all approach can be utilised across all populations affected by IBD. This may be because the potential efficacy of probiotics (for example such as Lactobacillus spp. and Bifidobacterium spp) will depend on the microbiological and physical properties of the strain or strains that it contains. In other words, efficacy of each probiotic strain and not species is group dependant (8). There is very little evidence at the present time surrounding the use of prebiotics in the nutritional management of IBD, but it has been postulated that, like probiotics, prebiotics may assist in the attenuation of the inflammatory process in IBD (19). Therefore, more research is required in this up-and-coming area before any firm clinical recommendations can be made as to their use (39).

Despite the equivocal nature of the data surrounding the modulation of gut flora, individuals with IBD have an increased risk of developing malnutrition (29) and, therefore, it is best practice to consider the following evidenced based nutritional interventions in the management of patients with IBD (see Figure 1).

NUTRITIONAL INTERVENTION IN IBS

There is no consistent evidence that IBS patients suffer from food allergy, nor is there documented evidence that food intolerance plays a role in IBS symptoms (14, 15). This is a very controversial area, however, and one recent study has refuted this claim suggesting that there may be potential value in eliminating certain foods which may increase immunoglobulin G levels which have been shown to cause diarrhoea in some IBS patients (22). However, it is important to note that restricting food groups from the diet carries nutritional risks and should not be undertaken without support from a qualified dietitian (35).

Recent advances in the understanding of the role of microbial dysbiosis in IBS indicate that the GI microbiota may be a potential therapeutic target in the nutritional management of this disorder (36). To date there are currently six meta analyses examining the role of probiotics and their use in the management of IBS. Whelan and Quigley (44) suggest that, whilst some probiotics show clear potential in the nutritional management of IBS, it is important to note that this is very much 'strain specific'. Therefore, each probiotic strain needs to be subjected to rigorous testing using randomised clinical trials (RCT) before any therapeutic benefits are suggested (43). In light of this evidence, it is best practice to advise patients with IBS who choose to try probiotics to take the product for at least four weeks and if no clinical benefit is achieved to try an alternative probiotic product with a different strain (32).

The data surrounding the use of prebiotics in the management of IBS is complex and beyond the scope of this article. Whelan (43) advocates that, whilst the use of prebiotics may help to attenuate the symptoms of IBS, as with probiotics, the dose is important in determining whether the prebiotic may confer a positive or negative impact on symptoms (43). It is prudent, therefore, to suggest that more RCTs are required in order to ascertain the impact that diets which are either supplemented or devoid of prebiotics may have on IBS symptoms.

Evidence is building to implicate fermentable oligosaccharides, disaccharides, monosaccharides and polyols (FODMAPs) in the onset of abdominal pain, bloating, wind and altered bowel habit through their fermentation and osmotic effects in the gut, as experienced in some IBS patients (3). Four clinical trials have been published to date, all with significant symptomatic response to the low FODMAP diet. Up to 86 percent of patients with IBS have achieved relief of overall gastrointestinal

symptoms and, more specifically, bloating, flatus, abdominal pain and altered bowel habit from the approach (2). However, although a low FODMAP diet appears to be more effective than standard dietary advice for symptom control of IBS, it is important to take into account the limitations of the research (20). Furthermore, it is also important to note that such findings may not be applicable to all members of the population, as each one is an individual (6).

CONCLUSION

As this review has demonstrated, gut health is important in maintaining gut function, as well as having a significant impact on general health and wellbeing. This critical function is due in part; to the complex inter relationship between the gut barrier and the gut microbiome. Therefore, it is important to establish a healthy gut flora from birth in order to try to prevent the onset of some GI diseases and other health related problems, including low immunity.

There is some evidence to suggest that the use of prebiotics, probiotics and some functional foods may provide some relief from the symptoms of both IBD and IBS. To date, no firm recommendations may be made with regards to the use of prebiotics and probiotics in the management of individuals with IBD, although this is promising (39). However, when considering the use of probiotics in the nutritional management of IBS, patients should be given advice which is individualised and tailored to their specific symptoms. Moreover, patients should also be advised that it is best to try a different strain of probiotic, i.e. yoghurt or fermented milk drink after a four-week period if their initial choice has not had any physiological impact on their IBS symptomology (35). Further large studies are required using probiotics with specific strains, in well-defined patient groups using robust patient outcomes to facilitate valid, reliable results (43).

The evidence surrounding the use of prebiotics in the nutritional management of IBS is equivocal, but there is most certainly promise in this area and more randomised controlled trials are required to enable the development of specific guidelines (43).

Finally, it is prudent to suggest that the use of a low FODMAP diet is the most promising type of therapy for patients with IBS, as studies have identified that 74 percent of individuals who follow this treatment show an improvement in their symptoms (3). Furthermore, a low FODMAP diet is relatively easy to implement without serious nutritional concerns caused by dietary restrictions.

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Questions relating to: *Nutritional influences on gut health.*
Type your answers below and then **print for your records.** Alternatively print and complete answers by hand.

Q.1	What is the primary function of the gut?
A	
Q.2	How does health and wellbeing impact on the gut?
A	
Q.3	What is the intestinal epithelium?
A	
Q.4	What is the role of the GI microbiome?
A	
Q.5	What can be the effects of dysbiosis?
A	
Q.6	Describe the main factors that influence the intestinal flora of an adult.
A	
Q.7	How can probiotics help in modulating the affect of GI microbiota?
A	
Q.8	What is the best-practice advice for patients with IBS who wish to try probiotics?
Q.9	What benefits can a low FODMAP diet have on IBS symptoms?
Q.10	In the nutritional intervention of an IBD patient with a nutrition deficiency, what recommendations would be made?

Please type additional notes here . . .