Fibre: An essential nutrient for children in health and disease – applying recommendations of an expert consensus


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Fibre is an essential nutrient for human health that has short and long-term benefits.[1] Despite this, most children, including those with disease-related malnutrition receiving nutrition support, fall short of daily recommended intakes. Evidence to support restriction of fibre in specific disease states is lacking, however, healthcare professionals (HCPs) often advise low fibre diets.

A recent review evaluated evidence underpinning current fibre recommendations in healthy children, and those requiring nutritional support.[1] The microbiome and the role of fibre in maintaining health within and beyond the gut were considered. This article provides a summary of the consensus statements arising from the review and offers some practical suggestions on how to apply in clinical settings.

Summary – consensus statements[1]

Current dietary fibre recommendations for children: quality or quantity?

- The quality of the fibre consumed is equally important as the quantity; the advice to HCPs is to focus on both.
- Both fermentable and bulking fibres help maintain a healthy bowel and confer health benefits beyond the gut, so a combination of both is needed.

Fibre and the gut microbiome

- Fibre plays an essential role in maintaining the structure and function of the gut microbiome to benefit host health.
- Lack of dietary fibre (especially from mixed sources) can lead to a disrupted microbiome.

Benefits of fibre beyond digestive health

- There are short-term and long-term health benefits associated with consuming dietary fibre which not only include gut-health benefits, but also benefits to other organs and systems beyond the gut.

Functional benefits of fibre for children receiving nutritional support

- There are no known contraindications to consuming the recommended amount of fibre in healthy children or those receiving nutritional support.
- Fibre is an essential nutrient – enteral formulas containing a combination of bulking and fermentable fibres should be used for children requiring nutritional support.

Role of fibre in the management of children with functional gastrointestinal disorders (FGIDs)

- Preclinical data suggest that a balanced diet which includes a range of fibre sources may support a healthy microbiome and thereby reduce the risk of some of these conditions, while promoting general health in these children.

Practical application of these statements in the clinical setting

Current dietary fibre recommendations for children: quality or quantity?

International recommendations provide a guide to the amount of fibre children should consume daily (**Table 1**). However, recommendations do not specify the *quality* or sources of fibre that should be consumed. This is important because fibre from various sources has markedly different physiological/functional effects.[1]

Fermentable fibres *pass undigested into the large intestine, where they are metabolised by commensal colonic bacteria under anaerobic conditions.*[1] Microbial fermentation increases bacterial biomass in the colon, including species such as *Bifidobacteria* and *Lactobacillus*. These bacteria produce metabolic by-products, such as short-chain fatty acids (SCFAs) including acetate, propionic and butyrate. SCFAs are absorbed into the bloodstream where they exert numerous short- and long-term health-related benefits. SCFAs create an acidic environment, increasing the solubility and absorption of minerals, including calcium (which is important for bone health), magnesium and possibly iron.[2, 3, 4, 5] Contrary to what is commonly believed – i.e. fibre reduces mineral absoption – these fibres appear to enchance mineral uptake in the gut.

Bulking fibres *reach the distal colon where they have considerable water-holding capacity, help to bulk the stool,*[6, 7] *reduce stool transit time and help remove certain toxins.*[2]

The combination of fermentable and bulking fibres is therefore important to the health of the child. This is also in line with the diet diversity or food diversity theory which has long been recognised by experts as key to a high-quality diet.[8]

The advice to HCPs in this consensus is to focus on both the amount and source of dietary fibre provided. Foods that supply a blend of fermentable and bulking sources should be encouraged (**Table 2** provides some examples). In children receiving nutrition support, HCPs should also select feeds that contain both fermentable and bulking sources, especially for children on long-term nutrition support.

Dietary recommendations for fibre are rarely met by children, regardless of the country or health status of the child.[9, 10] The European fibre recommendations are presented in **Table 1**. Fibre is an essential nutrient; just like other essential nutrients it should be included in the dietary advice provided by HCP to patients.

Fibre and the gut microbiome

The human gut microbiome is an ecosystem made up of billions of bacteria, viruses and fungi representing around 1000 different species.[1] Carbohydrates are known to shape the gut microbiota and its metabolic activity in early life.[1] The benefits of fibre in promoting the health of the gut microbiome have often gone unnoticed, despite the fact that prebiotics are (fermentable) fibres;[2] though not all fibres are prebiotic in nature. Fermentable fibres are therefore essential to maintain a healthy microbiome, while lack of these fibres has been associated with microbiome disruption and increased risk of certain diseases – e.g. inflammatory bowel disease (IBD)[11] and other FGIDs.[12]

Benefits of fibre beyond digestive health

Studies have consistently reported health benefits of dietary fibre that go beyond the health of the gut. SCFAs, the by-products of fermentation, are associated with beneficial effects on the immune system. They may be protective against certain allergic and autoimmune diseases.[1, 13] Each individual SCFA plays a specific role in promoting host health. HCPs should therefore encourage fermentable fibres when offering dietary advice to patients, including those receiving enteral tube feeding, to support health within and beyond the gut.

Functional benefits of fibre for children receiving nutritional support

There are no known contraindications to consuming the recommended daily amount of fibre in children receiving nutrition support.[1] Consequently, fibre-based feeds can be considered first line in most cases. An exception is active disease – e.g. Crohn's disease, where fibre may need to be temporarily avoided, but it should be reintroduced once the child achieves remission. Furthermore, in children with habitually low fibre intake, common in some cases of disease-related malnutrition (DRM),[9, 10] the amount and sources should be increased gradually to achieve tolerance.[1] In practice, for these children, HCPs should consider foods or feeds with a lower fibre content initially, building it up gradually to achieve daily requirements.

Role of fibre in the management of children with FGIDs

The role of fibre in the management of FGIDs has long been debated. FGIDs are very common and include, to name a few, infant regurgitation and colic, functional disorders including diarrhoea, constipation, nausea, vomiting, abdominal pain and defecation-related disorders in children and adolescents.[1] This consensus suggests that a balanced diet, including a range of fibre sources, may reduce the risk of some of these conditions, while promoting the general health of these children.[1] The advice to HCPs is therefore not to restrict fibre in children with FGIDs but to encourage them to consume amounts and sources (fermentable and bulking) similar to that of healthy children.

Table 1: Daily fibre recommendations (g/day) by age for children in UK and Europe

Country/ region	Author/ authority	Year of publication	Daily fibre recommendation
UK	UK Scientific Advisory Committee on Nutrition[14]	2015	Age 2-5 years: 15 g/day Age 5-11 years: 20 g/day Age 11-16 years: 25 g/day Age 16-18 years: 30 g/day
Europe	European Food Safety Authority[15]	2017-2019	Age 1-3 years: 10 g/day Age 4-6 years: 14 g/day Age 7-10 years: 16 g/day Age 11-14 years: 19 g/day Age 15-17 years: 21 g/day

Table 2: Common food sources of fermentable fibre and bulking fibre

Common food sources of fermentable fibre	Common food sources of bulking fibre
Garlic, onion, chicory root, bananas, asparagus	Whole bran cereals, wholemeal breads, whole bulgur wheat
Beans, some root vegetables, potatoes, dairy products	Unrefined oatmeal, oat-bran cereals
Fruit, vegetables, wheat	The cell wall of plants, e.g. skin of fruit, some vegetables, legumes
Soybeans, 'edamame' or young soybeans	

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CASE STUDY EXAMPLE

A 7-year-old boy recovering from active Crohn's disease with poor nutritional status, restricted diet and very low fibre intake

Introduction: This 7-year-old boy recovering from active Crohn's disease (CD) presented in clinic 7 weeks after diagnosis.

Case presentation: He was initially diagnosed with CD, weight loss, poor nutritional status, lethargy, nausea, abdominal pain and bloody diarrhoea. He was treated with exclusive enteral nutrition (EEN) for a period of 6 weeks, followed by gradual food reintroduction. Following EEN with a polymeric fibre-free feed his disease status improved, with a reduction in disease markers (**Table 1**). However, at follow up his weight had not recovered (50th centile prior to diagnosis) (**Figure 1**), and his diet remained sub-optimal (**Table 2**).

Nutritional management plan: Due to poor weight gain and sub-optimal diet he was commenced on a fibre-containing oral nutritional supplement (ONS) [2 x 200ml PaediaSure Fibre/day (400 kcal)] containing the full spectrum of macro and micronutrients and a blend of fermentable and bulking fibres. The goal was to support catch-up weight gain, as well as providing additional energy, micronutrients and fibre. He was advised to broaden his diet to include more nutrient-dense and fibre-based foods (fermentable and bulking), which should be increased gradually to support tolerance. He was also prescribed 10 ug vitamin D/day, according to standard practice for these patients.[2, 3]

Discussion: This is a typical case of an inflammatory bowel disease (IBD) child with poor nutritional status and very low fibre intake. Similar findings have been presented by others. Pituch-Zdanowska reported that fibre was restricted, often long-term, in IBD children.[6] While fibre plays an essential role in supporting the immune system and may prolong remission time;[6] they suggest changes in the composition of the intestinal microflora is considered crucial in the pathogenesis of IBD.[6] Diets characterised by high intakes of mono and disaccharides with low intakes of fibre, often advocated in underweight IBD children, have been linked to an increased risk of CD and ulcerative colitis (UC).[6, 7] Hou and colleagues (2012) concluded that excessive intakes of fat and meat was especially associated with CD and UC; while high fibre and fruit intake was associated with a decreased CD risk.[7] Therefore, when nutrition support is needed to achieve weight gain, all nutrient deficits should be considered including fibre, which is considered an essential nutrient.[8] Supplementation with an appropriate ONS product that provides the missing macro and micronutrients needed to achieve catch-up growth (energy, calcium, iron – all deficient (**Table 2**), plus fibre, ideally with a balance of 50% fermentable and bulking sources.

It has been suggested that SCFAs, produced by bacteria from fermentable fibres, positively promotes health by providing energy to colonic epithelial cells, with possible immunomodulatory and anti-inflammatory properties.[9] Interestingly, in this study IBD patients, especially those with CD, appeared to have reduced microbial biodiversity.[9] In another study by Desai et al. (2016) they reported that even in intermittent fibre deficiency, the gut microbiota resorts to other nutrient sources, leading to erosion of the colonic mucus barrier.[10] This may provide an explanation for why deviations or imbalances in the gut microbial community and dysbiosis correlate with IBD.[10] It is essential therefore that fibre, along with other essential nutrients, is re-established in the diet once the child is in remission. HCP sometimes limit the intake of fibre in the diets of IBD children,[8] when intakes are often already inadequate, which may be harmful to these children long-term.

In conclusion, children with CD who are in remission are often consuming inadequate dietary fibre along with other essential nutrients. Fibre, like all essential nutrients should be included in their diet to promote its health-related benefits.

Table 1: Biomarkers during active disease, in remission and ideal range

Biomarkers	Active disease status	Remission status	Ideal range[1]
CRP	40 mg/litre	<5 mg/litre	0-4 mg/litre
FC	3150 g/litre	20 g/litre	0-49 ug/litre
ESR	37 mm/hr	<10 mm/hr	0-10 mm/hr

Key: CRP = C-reactive protein; FC = faecal calprotectin; ESR = erythrocyte sedimentation rate.

Figure 1: Weight change prior to diagnosis (prior) versus active disease (active) and current (current) at week 7 follow-up

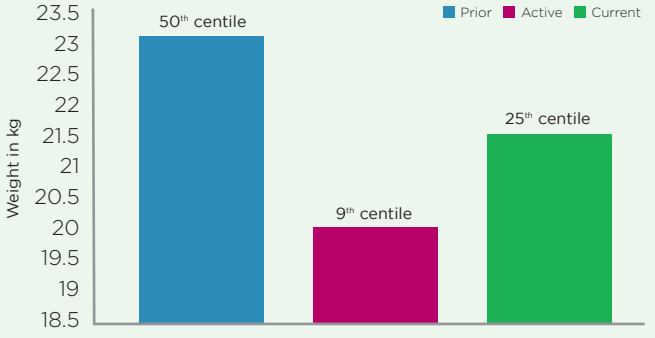

Table 2: Estimated daily nutritional requirements (for a 7-year-old boy) versus current intake

Nutrient	Reference	Estimated requirement	Estimated current intake
Energy, (kcal/day)	EAR	1750 (1650–1815) *(including 10% for catch-up weight gain)*[3]	1400
Protein, g/d	RNI	28.3	45
Fibre, g/d	DRV (EFSA & SACN)	16 (EFSA[4]) – 20 (SACN[5])	6
Iron, mg/d*	RNI	8.7	4.5
Calcium, mg/d*	RNI	550	300
Vitamin D, ug/d**	DRV	10	14

Key: EAR = estimated average requirement; DRV = dietary reference values; RNI = recommended nutrient Intakes; EFSA = European Food Safety Authority; SACN = Scientific Advisory Committee on Nutrition (UK).[5]

*up to 120% RNI;[3] **additionally supplemented 10 ug/day.[2]

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