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# Benefits of dietary fibre for children in health and disease

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## ABSTRACT

Fibre is an essential nutrient in the human diet that is crucial for human health. It provides a range of functional benefits, including stool bulking, and physiological benefits through fermentation of diverse fibre types by the gut microbiome including cholesterol lowering, glycaemic control and weight control. The by-products of the fermentation of fibre in the gut confer health benefits that extend beyond the gut to the immune system and organs such as the liver, kidneys and the brain. A lack of fibre in the diet has been associated with several disorders in children including constipation, irritable bowel syndrome, allergies and immune-related disorders. In paediatric practice, concerns exist over tolerance of dietary fibre which may lead to unnecessary restrictions, especially for children receiving nutritional support. One reason for this may be the terminology which has historically been used. Fibre is often described in terms of its physico-chemical properties (solubility, viscosity), rather than its physiological effects/functionality (fermentability, bulking effects). To describe fibre in these latter terms represents more clearly the important role it plays. Most international guidelines recommend a daily quantity of fibre, failing to mention the quality aspect of the fibre required for health. Here we consider the evidence base for the current recommendations for daily fibre intakes for healthy children, those requiring nutritional support and those with functional gastrointestinal disorders. We also consider the importance of the gut microbiome and the role of fibre in maintaining gut microbial health and its role in health beyond the gut.

## What is already known on this topic?

⇒ Fibre is an essential nutrient in the human diet that is crucial for human health.
⇒ Concerns exist over tolerance of dietary fibre in children with gastrointestinal disorders and those receiving nutritional support.

## What this study adds?

⇒ This review considers the importance of the quality of fibre consumed with regard to fermentable and bulking fibres.
⇒ Recommendations are made to ensure an age-appropriate quantity of fibre from a variety of sources to include both fermentable and bulking fibres.
⇒ The recommendations made are relevant for healthy children as well as those with functional gastrointestinal disorders or requiring additional nutritional support.

## INTRODUCTION

Fibre is an essential component of the human diet that is crucial for human health and as such, just like other essential nutrients, should be included in the diets of all children.[1] Fibre provides an energy source for the gut microbiome, an ecosystem made up of billions of organisms that inhabit our gut. The fermentation of fibre by the gut microbiome results in the production of a variety of compounds with short-term and long-term health benefits that extend beyond the gut, to the immune system and organs such as the liver, kidneys and even the brain.[2] The short-term benefits include supporting the immune system, especially within the gut itself, preventing or ameliorating autoimmune diseases such as diabetes, inflammatory arthritis, inflammatory gastrointestinal disorders and allergic disease. The longer-term benefits include a reduction in the risk of developing diabetes, obesity, hypertension, stroke and coronary heart disease in later life.[1 3] Conversely, a lack of fibre in the diet has been associated with several disorders in children including constipation, irritable bowel syndrome, allergies and other immune-related disorders.[4]

Despite the variety of health benefits dietary fibre confers, concerns exist over the tolerance of fibre which may lead to unnecessary restrictions, especially in children receiving nutritional support. One reason for the lesser use of this essential nutrient may be the terminology which has historically been used. Fibre has often been described by its physicochemical properties, such as its solubility or its viscosity, and not in the more relevant terms of its physiological effects/functionality. One such physiological description is fermentability. Fermentation of fibre in the anaerobic environment of the large intestine is the process which brings about most of the health benefits associated with fibre both within the gut and beyond. Another is the bulking effect of fibre, which facilitates gut motility and bowel movement. To describe fibre in these terms, that is, its functionality, presents more clearly the important role it plays in human health. Meanwhile, most international guidelines make recommendations only in terms of a daily dose (ie, quantity), failing to mention the quality aspect of the fibre required for health.

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In this review, we discuss available evidence on the recommendations for fibre intake in children and the benefits to child health. After thorough discussion, consensus statements (box 1) were reached for the following topics: recommendations for the daily intake of dietary fibre in healthy children, children requiring nutritional support and children with the most common functional gastrointestinal disorders (FGIDs), influence of dietary fibre intake on the gut microbiome and dietary fibre composition and its relationship with health and disease.

## DESCRIBING DIETARY FIBRE

Various definitions of what constitutes dietary fibre are currently used. The Institute of Medicine, Food and Nutrition Board defines dietary fibre as 'nondigestible carbohydrates and lignin that are intrinsic and intact in plants'.[5] In 2009, the WHO and the Codex Alimentarius Commission adopted a definition of dietary fibre as 'carbohydrate polymers with ten or more monomeric units, which are not hydrolysed by the endogenous enzymes of the small intestine of humans'.[6] Most recently, the International Carbohydrate Quality Consortium refers to dietary fibre as 'non-absorbed plant carbohydrates'.[7] These definitions are used to define daily recommended dietary intake as well as guide food labelling requirements. However, while widely accepted,[8] these definitions do not consider the variety and benefits of potential sources of dietary fibre.

## CURRENT DIETARY FIBRE RECOMMENDATIONS FOR CHILDREN: QUALITY OR QUANTITY?

Current recommendations for daily fibre intake for children vary and are largely extrapolated from recommendations for adults (table 1). In 1995, Williams *et al* recommended a (minimum) daily intake of fibre for children equivalent to age plus 5 g/day (up to a maximum of 10 g/day) for those over 2 years.[9] More recently, the Institute of Medicine recommended a daily total fibre intake of 14 g per 1000 kcal consumed for healthy adults.[10] Based on this recommendation for healthy adults, the recommended intake was extrapolated to 19 g/day for children aged 1–3 years, and 25 g/day for children aged between 4 and 8 years.[8] The European Food Safety Authority Dietary Reference Values for fibre are set at 10 g/day for children aged 1–3 years, 14 g/day for those aged 4–6 years, 16 g/day for those aged 7–10 years, and 19 g/day for those aged 11–14 years.[11] In 2015, the UK Scientific Advisory Committee on Nutrition (SACN) recommended a daily intake of fibre of 15 g/day for children aged 2–5 years, 20 g/day for those aged 5–11 years, 25 g/day for those aged 11–16 years and 30 g/day for those aged 16–18 years.[12] However, several studies have highlighted that otherwise healthy children are consuming far less fibre than these recommendations propose.[13–17] For example, in the recent UK National Diet and Nutrition Survey[17] only 14% of children aged between 4 and 10 years met 100% of the recommendation (20 g/day) set by SACN.[12] In fact, in all age groups, the mean intake of fibre was below the recommendations. Conversely, concerns have been raised that in young children with reduced gastric capacity, very high-fibre diets consisting mainly of vegetables, beans, pulses and wholegrain cereals may not provide sufficient energy for optimal growth.[18] Table 2 provides examples of sources of fibre as well as the fibre content within recommended portion sizes across paediatric age groups.

Of increasing concern is that the current recommendations for daily fibre intake refer to total fibre regardless of the source or fibre quality provided. This is important because different fibre types, and fibre from different sources, have markedly different physiological effects/functions providing benefits within and beyond the human gut once consumed (table 3).

**Box 1 Consensus on the importance of dietary fibre for children**

**Current dietary fibre recommendations for children: quality or quantity?**

⇒ The quality of the dietary fibre consumed by children is equally important as the quantity consumed; so, the advice to healthcare professionals is to focus on both.

⇒ Dietary recommendations for fibre are rarely met by children, however, they are a useful guide for both healthy children as well as for those requiring nutritional support.

⇒ Both fermentable and bulking fibres help maintain a healthy bowel (or healthy colon) and confer health benefits beyond the gut, so a combination of both is needed in the diet.

⇒ Some types of dietary fibre support the absorption of specific micronutrients including calcium and magnesium, contrary to the belief that high intakes of fibre reduce mineral absorption.

**Fibre and the gut microbiome**

⇒ Fibre plays an essential role in maintaining the structure and function of the gut microbiome to the benefit of host health.

⇒ Lack of dietary fibre (especially from mixed sources) can lead to a disrupted microbiome.

⇒ Further studies are needed to link fibre-induced microbiota shifts with changes in specific host physiological pathways regulating host metabolic and immune health.

**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 and therefore enteral formulas containing a combination of bulking and fermentable fibres should be used for children requiring nutritional support.

⇒ The daily requirements currently established for fibre intake are a useful guide for both healthy children and for those requiring nutritional support.

**Role of fibre in the management of children with FGIDs**

⇒ FGIDs are a common problem in children. 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.

**Role of fibre in the management of children with constipation**

⇒ Childhood constipation is a common, complex problem and poor fibre intake appears to have a causal link with its development. Including fibre in the diet from a range of sources to ensure intake of both fermentable and bulking fibres may support a healthy microbiome and help to prevent some forms of constipation in children.

FGID, functional gastrointestinal disorder.

| Table 1 Recommendations for daily fibre intake for children | | | |
|---|---|---|---|
| **Country** | **Source** | **Year of recommendation** | **Daily fibre recommendation** |
| UK | UK Scientific Advisory Committee on Nutrition[12] | 2015 | Age 2–5 years: 15 g/day<br>Age 5–11 years: 20 g/day<br>Age 11–16 years: 25 g/day<br>Age 16–18 years: 30 g/day |
| EU | European Food Safety Authority[11] | 2019 | Age 1–3 years: 10 g/day<br>Age 4–6 years: 14 g/day<br>Age 7–10 years: 16 g/day<br>Age 11–14 years: 19 g/day |
| USA | Williams *et al*[9] | 1995 | Age plus 5 g/day for those over 2 years (minimum) up to 10 g/day (maximum) |
| | Institute of Medicine (Institute of Medicine; Stephen *et al*)[8 10] | 2005 | Age 1–3 years: 19 g per 1000 kcal<br>Age 4–8 years: 25 g per 1000 kcal |

EU, European Union.

The diversity of fibre available for inclusion in the human diet, and the variety of physiological effects, functionality and benefits they confer, support the need to consider more than just daily total fibre intake but also the quality or source of the fibre. Table 4 provides examples of plant-based fibre included in the human diet categorised by fermentability—a characteristic that may change depending on the extent of processing (eg, milling) prior to consumption. The challenge is to determine the most relevant physiological properties of fibre in terms of human health, and the optimal proportion these different fibre sources should contribute.[19]

Solubility and a related property, viscosity, have long been the principal characteristics by which the quality of fibre is assessed. Solubility describes a physico-chemical property of fibre rather than the functional/physiological effects within the human gut. Insoluble fibres, such as that derived from cellulose and wheat bran, provide faecal bulk, stimulate bowel movement, dilute the colonic content (thereby protecting the gut from harmful substances) and adsorb undesirable colonic contents (eg, certain xenobiotics) ensuring their removal along with faecal matter, but they can also be fermented to varying degrees. Similarly, resistant starch can be soluble or insoluble and different resistant

**Table 2** Example sources of fibre and fibre content of portion sizes by age group for children

| | | | Portion size (g) and fibre content (g) | | |
|---|---|---|---|---|---|
| | **Fibre source** | **Fibre content per 100 g (as consumed)** | **1–5 years (daily target range: 10–15 g)** | **5–11 years (daily target range: 14–20 g)** | **11–16 years (daily target range: 19–25 g)** |
| Cereals and carbohydrates | Shredded whole wheat or bran cereals | 13–24 | 20 (2.6–4.8) | 30 (3.9–7.2) | 40 (5.2–9.6) |
| | Porridge oats | 8.0 | 25 (2.0) | 40 (3.2) | 50 (4.0) |
| | Bread | 7.0 | 25 (1.7) | 50 (3.5) | 100 (7.0) |
| | Whole-meal pasta (boiled) | 4.2 | 50 (2.1) | 65 (2.7) | 80 (3.4) |
| Fruits | Apple (medium size) | 1.8 | 50 (0.9) | 100 (1.8) | 150 (2.7) |
| | Figs | 6.9 | 25 (1.7) | 50 (3.5) | 100 (6.9) |
| | Strawberries | 3.8 | 20 (0.8) | 60 (2.3) | 80 (3.0) |
| | Banana | 2.6 | 25 (0.7) | 75 (2.0) | 100 (2.6) |
| | Oranges | 2.4 | 25 (0.6) | 75 (1.8) | 100 (2.4) |
| | Pears | 3.1 | 25 (0.8) | 75 (2.3) | 100 (3.1) |
| Vegetables | Broccoli | 2.8 | 10 (0.3) | 60 (1.7) | 80 (2.2) |
| | Peas (boiled) | 5.6 | 12 (0.7) | 60 (3.4) | 80 (4.5) |
| | Baked beans (in tomato sauce) | 4.9 | 50 (2.5) | 75 (3.7) | 100 (4.9) |
| | Carrots | 2.5 | 12 (0.3) | 60 (1.5) | 80 (2.0) |
| | Parsnip | 4.7 | 12 (0.6) | 60 (2.8) | 80 (3.8) |
| | Green beans (boiled) | 4.1 | 12 (0.5) | 60 (2.5) | 80 (3.3) |
| | Baked potato | 3.0 | 50 (1.5) | 200 (6.0) | 250 (7.5) |
| | Sweet corn (tinned) | 2.5 | 12 (0.3) | 60 (1.5) | 80 (2.0) |
| | Chick peas (boiled) | 4.3 | 60 (2.6) | 60 (2.6) | 80 (3.4) |
| | Lentils (tinned/cooked) | 7.9 | 40 (3.2) | 60 (4.7) | 80 (6.3) |
| Nuts and seeds | Almonds | 7.4 | 5 (0.4) | 5 (0.4) | 5 (0.4) |
| | Peanuts | 7.6 | 5 (0.4) | 5 (0.4) | 5 (0.4) |
| | Peanut butter | 4.0 | 12 (0.5) | 20 (0.8) | 30 (1.2) |
| | Sesame | 7.9 | 5 (0.4) | 5 (0.4) | 5 (0.4) |
| | Sunflower | 6.0 | 5 (0.3) | 5 (0.3) | 5 (0.3) |

Fibre content: https://www.bda.uk.com/resource/fibre.html and https://www.nutritionix.com/food/; portion sizes: https://www.lovefoodhatewaste.com/.

**Table 3** Characteristics of dietary fibre

| | |
|---|---|
| Source | Natural plant-based, processed, synthetic |
| Chemical composition | Chain length, polysaccharide composition, lignification |
| Physico-chemical properties | Solubility, viscosity, bulking, fermentability, particle size |
| Accompanying compounds | Vitamins, minerals, phytochemicals |

starches show different fermentabilities in different regions of the colon,[20] or at least may be fermented by different bacteria within the gut microbiota.[21] Some fibres have been shown to lower blood cholesterol and post-prandial glycaemia due to an increase in viscosity of the bowel content and a slowing of the fermentation of complex carbohydrates and other macronutrients.[22 23] So the quality of a dietary fibre in terms of potential to impact on human health might be better assessed by measuring its physico-chemical characteristics combined with its degree of fermentability and bulking.

The fermentability of fibre refers to the extent to which it can be broken down by the gut microbiota and is determined by the chemical and physical structure of the fibre and its accessibility to bacteria.[19] The speed and extent of fermentation differs between fibre from different sources. Fermentation of fibre in the human gut results in the production of short-chain fatty acids (SCFAs) which stimulate gut motility and have multiple benefits within and beyond the gut including maintaining the effective barrier function of the gut wall and anti-inflammatory properties.[19] SCFAs are known to increase colonic mineral absorption (eg, calcium and magnesium), stimulate the growth of beneficial bacteria (eg, bifidobacteria) in the gut (through cross-feeding) and increase bacterial biomass which can benefit bowel movement.[19 24 25] Bulking (non/poorly fermentable) fibre is predominantly insoluble and so confer the benefits outlined above for insoluble fibre. A healthy diet should contain both fermentable and bulking fibre.

## FIBRE AND THE GUT MICROBIOME

The human gut microbiome is an ecosystem made up of billions of bacteria, viruses and fungi representing in the region of 1000 different species. The precise composition of microbial species and strains varies between and within individuals, during times of health and disease and according to major life stages. From the earliest stages of intestinal colonisation, carbohydrates shape the composition, successional development and metabolic activity of the gut microbiota. Human milk oligosaccharides, the third most abundant component of breast milk, are not digested by human enzymes and act as substrates for gut bacteria, selectively stimulating bifidobacteria, which become the dominant microbiota members in breastfed infants. Later, upon complementary feeding, with the introduction of various dietary fibres in solid foods, a more complex and diverse microbiota develops, driven by interactions between fibre physico-chemical properties and enzymatic capabilities of different gut bacteria. A high degree of cooperation and mutualistic behaviours occur between different bacteria during the fermentation of dietary fibre. Similarly, different bacterial populations will use different fermentation by-products as their main energy source. In this way, cross-feeding is responsible for the structure and high degree of self-regulation and homeostasis observed within the gut microbiome community from the age of about 3 years.[26] The SCFAs, acetate, propionate and butyrate are the major end products of fibre fermentation by the gut microbiota in the ratio of approximately 60:20:20. These organic acids have important physiological effects both within the gut and systemically. Butyrate provides about 50% of the daily energy requirements needed for the intestinal mucosa, and SCFAs regulate intestinal permeability, mucin production, apoptosis (critical for protection from intestinal cancers), peristalsis and secretion of incretins which regulate our satiety and food intake.[27] SCFAs are absorbed from the gut via both passive and active transport, indeed active transport via monocarboxylic transporter 1 is highly efficient and is responsive to SCFA production in the gut.[28] Similarly, disruption of the gut microbiota or microbiota dysbiosis, including reduction in SCFA ratio and concentration, has been implicated in metabolic and immune-related diseases. Both the composition of the gut microbiota and its metabolic activity, largely driven by fibre fermentation, are important players in the development of both chronic non-communicable diseases, and also in infection incidence and severity.[29] A major research challenge still persists, however, in defining the composition of a healthy gut microbiome and the dietary fibre quantity, source and composition needed to promote and support such a healthy gut microbiome.

## BENEFITS OF FIBRE BEYOND GUT HEALTH

Data from both epidemiological and interventional studies have consistently demonstrated the broad and long-term health benefits of dietary fibre including cholesterol lowering, glycaemic control, prevention of constipation, colon cancer and diverticular disease, weight control[30] and, more recently, cognition in prepubertal children.[31 32]

SCFAs enter the bloodstream (especially acetate and propionate,[33] as butyrate is largely used by the gut microbiota), where they appear to confer beneficial systemic effects on the immune system such as promoting T cell differentiation and associated immunity and immune tolerance.[34] SCFAs may also be protective against allergy development,[35] as well as having broader anti-inflammatory effects with potential benefits in terms of preventing or ameliorating autoimmune diseases such as diabetes, inflammatory arthritis, inflammatory gastrointestinal disorders and allergic disease.[35 36] They may also provide

**Table 4** Examples of fermentable and bulking (non-/poorly fermentable) plant-based fibre

| Fermentable fibre | Non-/poorly fermentable fibre* |
|---|---|
| Fruits and vegetables (soluble polysaccharides. Sources: garlic, onion, leeks, chicory root, asparagus, bananas, beans, dairy products) | Wheat bran |
| Grains (soluble polysaccharides such as glucan. Sources: oats, barley) | Oat bran/hull |
| Inulin (sources: fruits, vegetables, herbs, wheat) | Cellulose |
| Soy polysaccharide (source: soybean) | Lignin |
| Gum arabic (source: gum of the Acacia tree) | Alginate |
| | Methylcellulose |

*Dependent on the extent of processing (eg, milling) which may increase the fermentability of fibre.

protection against other chronic diseases of an inflammatory nature including obesity and related pathologies and cancer.[37] Acetate plays important roles in the liver and also systemically, acting as a substrate for cholesterol biosynthesis, an energy source, an epigenetic agent and in regulating adipocyte differentiation and thermogenesis.[38] Propionate, which is largely cleared by the liver, plays an important role in regulating hepatic cholesterol biosynthesis and gluconeogenesis, and along with acetate, also impacts on adipose tissue metabolism and inflammatory output.[39] These physiological activities are mediated either through pathways regulated by the free fatty acid receptors FFAR-1 and FFAR-2 (G-protein coupled receptors 41 and 43, respectively), and/or histone deacetylase activities.[40]

A meta-analysis of epidemiological studies in adults conducted in 2015 found that an increase in dietary fibre of 7 g per day was associated with a statistically significant reduction in the risk of cardiovascular disease (9% risk reduction; $p<0.001$), haemorrhagic and ischaemic stroke (7% risk reduction; $p=0.002$), colorectal cancer (8% risk reduction; $p=0.02$), rectal cancer (9% risk reduction; $p=0.007$) and diabetes (6% risk reduction; $p=0.001$).[12] A 2019 meta-analysis found that the risk reduction for these diseases was greatest when the daily fibre intake in adults was between 25 g and 29 g, a fibre intake that was associated with a 15% risk reduction for all-cause mortality.[41]

Further studies are needed to define the optimal composition of the total daily intake of fibre in children to maximise these broader health benefits as well as those related to gastrointestinal health.

## FUNCTIONAL BENEFITS OF FIBRE FOR CHILDREN RECEIVING NUTRITIONAL SUPPORT

Fibre-containing enteral formulas for oral nutritional support or tube feeding are not routinely used for the majority of children with normal gut function who require nutritional support and are often reserved for the management of certain gastrointestinal conditions. However, clinical studies support the use of fibre in enteral nutrition formulas.[42–48] In these studies, the benefits for children requiring nutritional support include decreased diarrhoea, lower stool pH, improved bowel frequency and improved microbiota profiles (increased proportions of bifidobacteria) in stool samples. For children habitually consuming low-fibre diets being initiated on nutritional support, the daily fibre intake from oral and enteral formulas may need to be increased gradually towards the daily recommended intakes to establish tolerance. All children, including those receiving nutritional support, will benefit from the inclusion fibre from a range of sources.[49]

## ROLE OF FIBRE IN THE MANAGEMENT OF CHILDREN WITH FGIDS

FGIDs encompass a range of disorders of the gastrointestinal tract including infant regurgitation, infant rumination, cyclic vomiting syndrome, infant colic, functional diarrhoea, infant dyschezia and functional constipation in neonates and toddlers, functional nausea and vomiting disorders, functional abdominal pain disorders and functional defecation disorders in children and adolescents.[50 51] Studies suggest that between 20% and 32% of children have an FGID.[52 53] FGIDs in children are associated with reduced quality of life as well as reduced physical, social and emotional functioning and time lost at school.[54] Outcomes for children with FGIDs are poor; almost half will continue to experience symptoms for several years after their initial diagnosis and around one in four will still be living with symptoms into adulthood.[54]

There is, however, a lack of large, randomised placebo-controlled trials evaluating the effect of consuming fibre from different sources in children with FGIDs. The studies that have been conducted, while indicating that dietary fibre is beneficial for children with FGIDs, have not distinguished between fermentable and/or bulking fibre in these patients.[54] Moreover, the heterogeneity in study design, the type of fibre and fibre combinations used, length of follow-up and outcome measures preclude the development of evidence-based guidelines for dietary fibre in the management of FGIDs in children.[54] Future studies should focus on the potential benefits of dietary fibre from different sources in the management of children with infant colic, irritable bowel syndrome, functional diarrhoea and functional constipation.

## ROLE OF FIBRE IN THE MANAGEMENT OF CHILDREN WITH CONSTIPATION

The World Gastroenterology Organisation and the National Institute for Health and Care Excellence recommend encouraging a gradual increase (over several weeks) in daily fibre consumption with a focus on whole-fibre foods for the management of functional constipation, in combination with laxatives and behavioural interventions.[55 56] Recommendations from the European Society for Paediatric Gastroenterology, Hepatology and Nutrition (ESPGHAN) and North American Society For Pediatric Gastroenterology, Hepatology & Nutrition (NASPGHAN) recommend a normal fibre intake for children with functional constipation but lack any specific guidance on the type or source of fibre that might be most beneficial for these children.[57] Moreover, there is a lack of systematic data for the fibre types that may be beneficial in terms of addressing the functional component of this disorder in children. A meta-analysis of 10 studies in a total of 690 children with functional constipation and a further follow-up study in 80 children evaluated the effect of seven different fibre mixtures with or without prebiotics compared with placebo or a control treatment.[58] While the fibre types used in the studies perhaps did not reflect those most likely to offer a benefit for relief of constipation (ie, bulking fibre), a number of the prebiotic fibre combinations provided promising results.[59] However, these studies are highly heterogeneous in terms of design, populations evaluated, duration of treatment and follow-up, type and dose of prebiotic fibre and outcomes evaluated.[59] Therefore, the role of fibre supplementation in the treatment of childhood constipation remains unclear and further well-designed high-quality randomised controlled trials are needed to better define the sources of fibre most beneficial for these children and their proportion of the daily total fibre intake. Until data from such studies are available, dietary interventions alone should not be used as a sole or first-line treatment for chronic constipation in children.[54] However, it is advisable to ensure a normal fibre intake.[54]

## CONCLUSIONS

Fibre is an essential nutrient and its importance for human health is often overlooked. The physiological and functional effects of dietary fibre are associated with a wide range of short-term and long-term health benefits, and additional research on both the quality and quantity of fibre consumed by all children is warranted. Current recommendations suggest a daily amount of fibre in the region of 10 g/day for young children increasing to around 20 g/day for adolescents.

The importance of the quality of fibre consumed is increasingly recognised with fermentable fibre essential for maintaining a healthy microbiome, with all the associated benefits this confers within and beyond the gut. Bulking fibre is required as a stool-bulking agent to promote gut motility, bowel movement and removal of unwanted toxins. Given the lack of contraindications for fibre in children requiring nutritional support, oral and enteral formulas should contain an age-appropriate quantity of fibre from a variety of sources to ensure both fermentable and bulking fibres are consumed. Where gastrointestinal tolerance might be a concern on initiating nutritional support in some children, for example, those with habitually low-fibre intakes, a gradual increase in fibre should be considered with the aim of achieving a comparable daily intake with that recommended for healthy children.

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