Nutrition Centre

By TATE & LYLE

The importance of fibre consumption in children

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A healthy diet in childhood (defined by WHO as <18 years of age[1]) with adequate amounts of all nutrients, is essential for optimal health, growth and development. Whilst the role of vitamins and minerals in childhood is well-recognised, the importance of fibre is often overlooked[2]. Evidence clearly shows that fibre is a nutrient of concern for children of all ages, and the gap between fibre recommendations and intakes is still too wide.[2]

Different types of dietary fibre have unique functions that play a crucial role in human health.

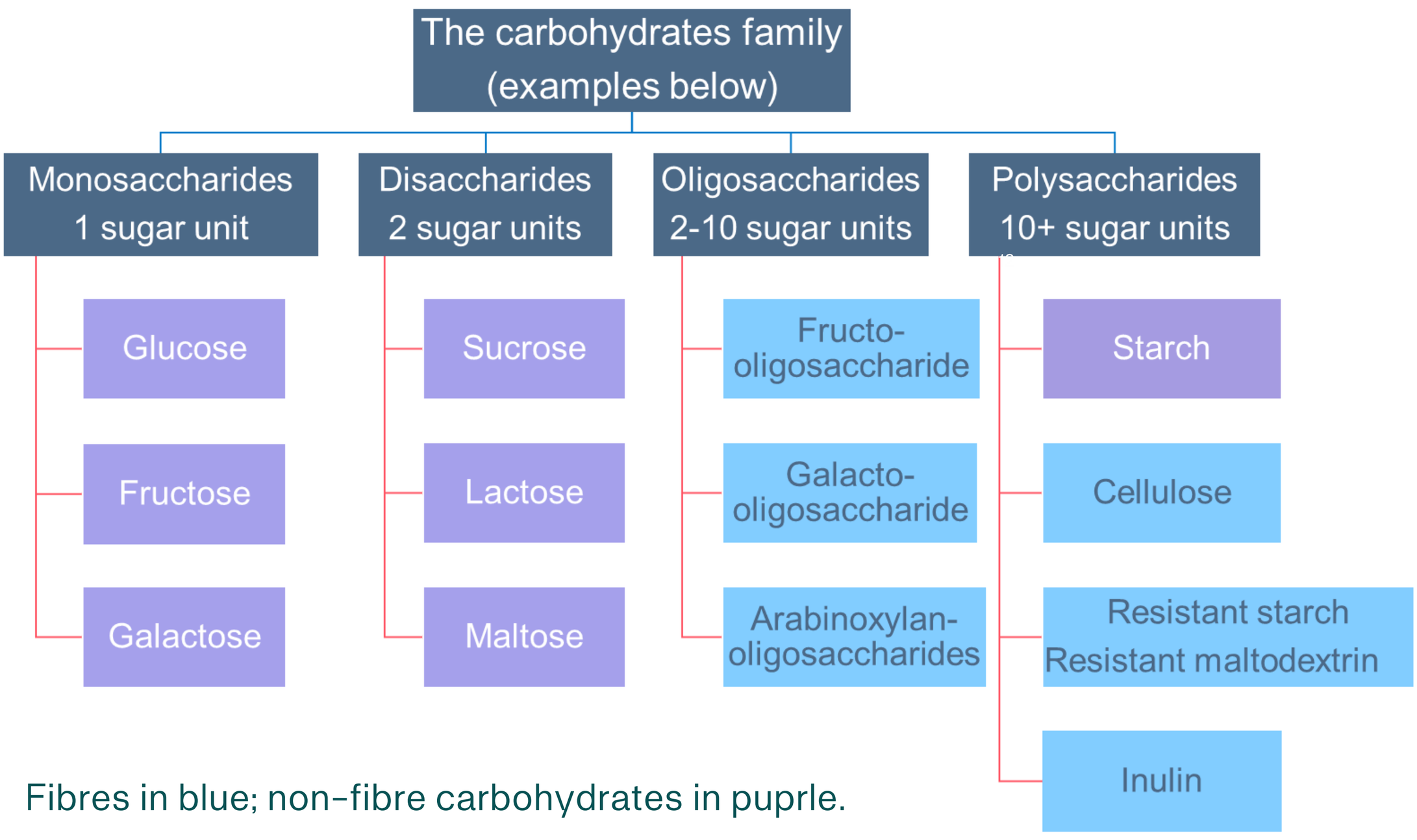
Dietary fibre is known to benefit gut health, supporting normal bowel function, but it also helps maintain healthy after-meal (postprandial) blood glucose levels. Furthermore, fibre may contribute to feelings of fullness after eating – a matter of huge significance considering the globally-high prevalence of obesity in children.[2]

This brochure explores recommendations for fibre intake in children and provides an insight into the degree to which targets are being missed in many countries. Implications for children's health outcomes are explored along with strategies to improve their fibre intakes.

Defining fibre

Fibre is part of the dietary carbohydrates family which includes monosaccharides and disaccharides, as well as oligosaccharides and polysaccharides.[3]

As shown in Figure 1, the fibre sub-group includes non-digestible oligosaccharides, resistant starch and non-starch polysaccharides. These are saccharides that contain three or more monomers (monosaccharide units), connected by bonds that cannot be digested by human enzymes.



Fibres in blue; non-fibre carbohydrates in puprle.

Figure 1: How fibre fits within the carbohydrates family

Fibres were first identified around 130 BC when Galen, a physicist, observed that some foods 'boosted' intestinal function and others hindered it. Since then, the term dietary 'fibre' has undergone several iterations and is now an umbrella term for a range of non-digestible, soluble and insoluble fibres with differing viscosity and either fermentable or non-fermentable.[4]

In 2009, the World Health Organisation (WHO) and Codex Alimentarius Commission (CAC) provided a global definition of fibre as carbohydrate[5] polymers with ten or more monomeric units[a] which are not hydrolysed by the endogenous enzymes in the small intestine of humans.

The decision to include fibres with 3-9 monomeric units was left to individual jurisdictions, with several such as the UK and EU deciding to include these fibres.

This definition recognises all substances that are non-digestible and come from natural, extracted or synthetic origins. A universal definition enables standardisation and international harmonisation for labelling and food composition tables. In 2009, CAC segmented dietary fibre into three categories:

A	Natural dietary fibre, present in consumed foods
B	Dietary fibre obtained from food raw material by physical, enzymatic or chemical
C	Synthetic carbohydrate polymers

Whilst fibres in Category A do not need to demonstrate any health benefits, those in Categories B and C must have proven health benefits. Prebiotics also have a harmonised definition as: "a substrate that is selectively utilised by host microorganisms conferring a health benefit".[6]

Table 1 lists examples of dietary fibres in natural, extracted and synthetic forms, along with their physical properties.

[a] Definitions in some countries may include 3+ monomeric units

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Table 1: Types, sources and characteristics of selected dietary fibres

Fibre type	CHO type	Solubility	Viscosity	Fermentability	Food Sources	Key Benefits
Cellulose, hemicellulose	P	None	Non-viscous	Low	All green plant cell walls (fruit & vegetables), cereal grains	Adds bulk to stools; laxative effect
Lignins	P	None	Non-viscous	Low	Wheat & corn bran, unripe bananas, vegetables	Adds bulk to stool; laxative effect
Arabinoxylans	P	Low to medium	Medium	Low-high	Wheat, rye, barley	Prebiotic[b]; Adds bulk to stools
Fructo-oligosaccharides	O	Medium	Low-high	High	Onion, asparagus, Jerusalem artichokes	Prebiotic; adds bulk to stool; laxative effect
Beta-glucans	P	Medium	Medium-high	High	Oats, barley, fungi	Adds bulk to stools; can help normalise blood cholesterol; prebiotic
Galactomannan	P	Low to medium	Medium-high	High	Guar gum, fenugreek	Can help normalise blood cholesterol and support glycaemic control
Pectin	P	High	Medium-high	High	Fruits (apples, berries)	Minimal bulking & laxative effects; gelling properties; can help normalise blood cholesterol and support glycaemic control
Inulin	O	Medium to high	Varies	High	Wheat, fruits, vegetables (onion, chicory, banana, leek)	Bulking & laxative effects; supports glycaemic control; prebiotic
Galactooligosaccharides	O	High	Low	High	Pulses	Prebiotic
Dextrin	P	High	Non- or low-viscous	High	Cereals (e.g. wheat dextrins)	Can help normalise blood cholesterol and support glycaemic control
Methylcellulose	P	High	High	Non-fermentable	Synthesised source	Adds bulk to stools; laxative effect. Can help normalise blood cholesterol and support glycaemic control
Psyllium	P	High	High	Non-fermentable	Psyllium seeds	Can help normalise blood cholesterol and support glycaemic control
Resistant starches	P/O	Variable	Non- or low-viscous	Mostly high	Wholegrains, legumes, unripe bananas, cooked/cooled starch (e.g., cooked pasta)	Adds bulk to stools but minimal laxative effect; supports glycaemic control; prebiotic
Polydextrose	O	High	Non-viscous	High	Synthesised source	Adds bulk to stools; mild laxative effect; can help regulate blood glucose and insulin responses, promotes satiety
Resistant Maltodextrin	O	High	Low	High	Extracted from corn	Increases faecal weight; mild laxative effect; promotes glycaemic control; prebiotic

b A prebiotic is defined as “a substrate that is selectively utilized by host microorganisms conferring a health benefit”

Table created:from Gill et al 2021[7],Lattimer 2017[8],Arroyo et al 2023[9] and Harvard University https://www.hsph.harvard.edu/nutritionsource/carbohydrates/fiber/

Key: CHO, carbohydrate; O, oligosaccharide; P, polysaccharide

Recommendations and intakes

Recommendations for dietary fibre were typically based on the amount required to maintain normal laxation and cardiovascular health. Now, it is becoming clear that the benefits of fibre go beyond this to encompass gut microbiome modulation, bone health and metabolic health. Although additional research is needed, emerging evidence shows that dietary fibre may support immune function.

The World Health Organisation[10] recommends that adults should ingest a minimum of 25g of fibre per day. Country-specific recommendations for adults range from 25 to 38g per day.[11-13]

Guidance on fibre intakes for children varies and appears to be largely extrapolated from adult recommendations (Table 2).

Consequently, there is some degree of confusion in determining what is an adequate intake at different ages although, as a general recommendation, the “age +5 g” (e.g. a 11-year-old would require 11 +5 g fibre daily) seems prudent.[14]

Table 2: Fibre recommendations by country

Country	Average fibre (g/day)	Age groups (years)	Reference
UK	15	2-5	Scientific Advisory Committee on Nutrition SACN Carbohydrates and Health Report - GOV.UK (www.gov.uk)
	20	5-11	
	25	11-16	
	30	16-18	
USA	14	2-3	US Department of Agriculture Dietary Guidelines for Americans, 2020-2025
	20 (M); 17 (F)	4-8	
	25 (M); 22 (F)	9-13	
	31 (M); 25 (F)	14-18	
EU	10	1-3	European Food Safety Authority Scientific Opinion on Dietary Reference Values for carbohydrates and dietary fibre | EFSA (europa.eu)
	14	4-6	
	16	7-10	
	19	11-14	
	21	15-17	
Canada	19	1-3	Canadian Paediatric Society The role of dietary fibre and prebiotics in the paediatric diet | Canadian Paediatric Society (cps.ca)
	25	4-9	
	31 (M); 26 (F)	9-13	
	38 (M); 25 (F)	14-18	
Australia/New Zealand	14	1-3	Eat For Health Australia Dietary fibre | Eat For Health
	18	4-8	
	24 (M); 20 (F)	9-13	
China	Age in years +5 = grams of dietary fibre		Department of Health, Hong Kong government Change4Health - 7. Dietary Fibre
	13	Age 8	
	15	Age 10	

Key: M, male; F, female

The fibre gap

Regardless which recommendations are used, it is clear that fibre intakes across the globe are falling well short of targets. On average, the fibre gap in Western nations is around 50%, as suggested by the data in Table 3.

In the UK,[20] only 2% of girls and 6% of boys aged 11-18 years met the fibre guidelines for their age in 2014-2016. The latest National Diet and Nutrition Survey[15] showed that just 4% of 11–18-year-olds consumed enough fibre, which is a negligible improvement from earlier years. The same survey revealed that teenage boys were consuming 16g of fibre per day on average, which is only 53% of the target.

A Canadian survey found that adolescent boys consumed, on average 19g fibre per day, not even reaching 50% of the daily target of 38g.

In certain populations in Western countries, the gap between recommendations and intakes is more marked. For example, children from low-income and ethnic minority families, and older girls, tend to lag behind other groups of children in terms of fibre intake[21,22].

Where food-based dietary guidelines exist, most people are not eating enough fruits, vegetables, legumes and wholegrains that contribute the most to fibre intakes. Consequently, multi-layered approaches to public health policy are needed to raise consumer awareness and promote foods high in fibre. Consumers are more likely to feel comfortable talking about foods rather than nutrients.

Table 3: Fibre intakes in children by country

Country	Average fibre (g/day)	Age groups (years)	Reference
UK	10.4	1.5–3	National Diet & Nutrition Survey[15]
	14.3	4–10	
	16	11–18	
USA	12.5 (M); 12.0 (F)	2–5	National Health and Nutrition Examination Survey 2017–20[16]
	14.7 (M); 14.7 (F)	6–11	
	15.4 (M); 13.6 (F)	12–19	
Canada	11.5	1–3	Canadian Community Health Survey[17]
	14.7	4–9	
	16.9 (M); 15.0 (F)	9–13	
	18.7 (M); 15.0 (F)	14–18	
Australia	16.6 (M); 15.1 (F)	2–3	National Nutrition and Physical Activity Survey 2011–12[18]
	19.4 (M); 16.3 (F)	4–8	
	21.1 (M); 18.1 (F)	9–13	
	19.8 (M); 17.9 (F)	14–18	
China	10.2 (M); 9.8 (F)	6–8	China National Nutrition and Health Surveillance 2010–12[19]
	12.2 (M); 11.4 (F)	9–11	
	14.0 (M); 13.0 (F)	12–14	
	15.0 (M); 13.5 (F)	15–17	

Key: M, male; F, female

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The evidence for fibre and health

In adult populations, there is plenty of evidence showing the potential impact of higher dietary fibre intakes on health, especially for cardiovascular health,[23] type 2 diabetes[24] and colorectal cancer[25]. Figure 2 below summarises the range of physiological effects attributed to various types of natural, isolated or synthetic fibres for the general population.

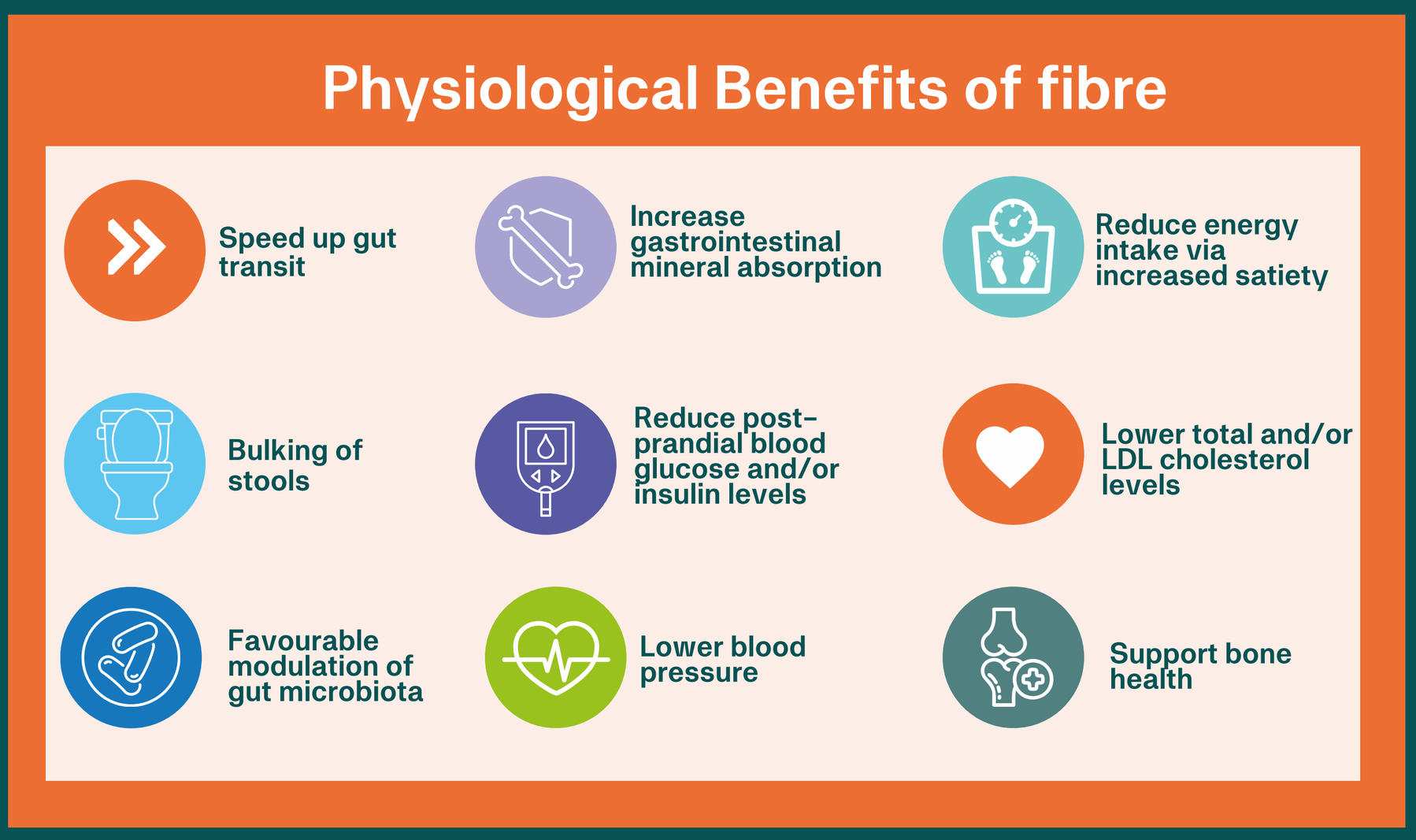

Figure 2: Physiological benefits of fibre for the general population
Adapted from McKeown[26]

Studies in children and adolescents have largely been confined to observational studies owing to the ethical and practical challenges of carrying out controlled intervention studies in these age groups. However, aspects that have been researched include gut function, metabolic health, cardiovascular health, immune function, body composition and bone health. As well as reporting positive health associations, observational studies typically show that children with higher dietary fibre intakes are more likely to have a better diet quality overall.[21]

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Gut function

Boosting dietary fibre is one of the main ways to promote intestinal health.[27]

In many countries, chronic constipation is a common problem amongst adults and children,[27] but there is limited and sometimes conflicting evidence that shows that fibre might support normal bowel function. The strongest evidence in children relates to the beneficial effects of prebiotics[28,29]. For fibre in general, studies suggest that diets with recommended amounts of fibre help to prevent constipation[30] but there is no agreement on whether supplementing fibre above this level helps.

Different fibres may have other effects on the bowel, including promoting a healthy gut microbiome[31-33] (defined as a balance of intestinal microorganisms[34]), improving symptoms of inflammatory bowel disease in 4–16 year olds,[35] managing functional abdominal pain in 4–18 year olds[36] (low certainty of evidence), and treating gastroenteritis (a condition characterised by diarrhoea and vomiting due to ingestion of pathogens)[37].

Table 4 provides a summary of this evidence.

Table 4: Summary of evidence on fibre and gut function in children

Type of study	Age groups (years)	Condition studied	Benefit	
Review of cross-sectional studies	3-17	Constipation and fibre	Unclear	Edwards[38]
Review of meta-analyes	Not stated	Constipation and fibre	Yes	Southwell[30]
Meta-analysis	0-18	Constipation and prebiotic/fibre mixtures	Yes	Wegh[29]
Review	0-18	Fermentable fibres and constipation	Yes	Hojsak[31]
Meta-analysis	4-18	Fibre and functional abdominal pain (recurrent/continuous pain)	Unclear	de Bruijn[36]
RCT	4-16	Inflammatory bowel disease and synbiotics	Yes	Baştürk[35]
RCT	2-14	Prebiotics and gastroenteritis	Yes	Noguera[37]
RCT	3-14	Prebiotic taken with antibiotic therapy	Yes	Nikolaou[33]
RCT	3-6	Prebiotic taken with antibiotic therapy	Yes	Soldi[32]

Key: RCT, randomised controlled trial

High fibre intakes (exceeding recommended or usual amounts), especially in the short term, have been linked with gastrointestinal side effects such as bloating, gas and diarrhea .[39]

However, studies in children suggest that moderate fibre fortification (6-9g daily) is well-tolerated provided there is a gradual introduction[40].

Metabolic health and diabetes

Evidence from observational studies in adults suggests that high fibre intakes are less associated with metabolic syndrome (a collection of cardiovascular and metabolic risk markers), and could reduce the risk of type 2 diabetes[41].

This is also the case when children and young people are studied, supported by cross-sectional studies,[42,43] and large cohorts[44] highlighting a lower risk of metabolic syndrome when fibre intakes are higher. Management of blood glucose levels is important for preventing type 2 diabetes and insulin resistance is a typical marker for poor glucose control. In three studies, higher fibre intakes were linked with lower insulin resistance[45-47].

Table 5 summarises this evidence.

Certain types of fibre, such as fructans, lower post-prandial glycaemia (blood glucose rise after food)[48] . Viscous or soluble fibres appear to slow the absorption of carbohydrates in the gut leading to a flatter rise in blood sugars[46].Beneficial changes to gut microbiota may also help protect against type 2 diabetes[49].

Table 5: Summary of evidence on fibre and metabolic health in children

Type of study	Age groups (years)	Condition studied	Benefit	Reference
Cross sectional	12–19	Fibre and metabolic syndrome	Yes	Carlson[42]
Cross sectional	10–17	Fibre and metabolic syndrome	Yes	Ventura[43]
Prospective cohort study	13–18	Fibre and metabolic syndrome	Yes	Fulgoni[44]
Prospective cohort study	16–19	Soluble fibre and insulin resistance	Yes	White[45]
Prospective cohort study	8–12	Fibre and insulin resistance	Yes	van Hulst[46]
Prospective cohort study	8–10	Fibre and insulin resistance	Yes	Kynde[47]
Prospective cohort study	8–10	Fibre and insulin resistance	*No*	Henderson[50]

Cardiovascular health

According to meta-analyses – the strongest type of evidence – higher fibre intakes (at the top tertile of intake) have a strong protective association against cardiovascular disease in adults[51].
This may be due to the fibre-lowering or vascular health properties of fibre. Evidence from prospective cohort studies in Australia[52] and the Netherlands[53] also suggest adolescents with higher fibre intakes have lower blood pressure.

In younger children, there is far less evidence but this points to benefits for higher fibre intakes as summarised in Table 6.

Table 6: Summary of evidence on fibre and cardiovascular markers in children

Type of study	Age groups (years)	Condition studied	Benefit	Reference
Prospective cohort study	0–20	Fibre and serum cholesterol	Yes	Pahkala[54]
RCT	15–19	Fibre and LDL cholesterol	Yes	González[55]
Prospective cohort study	11–23	Fibre and saturated fat	Yes	Goff[56]

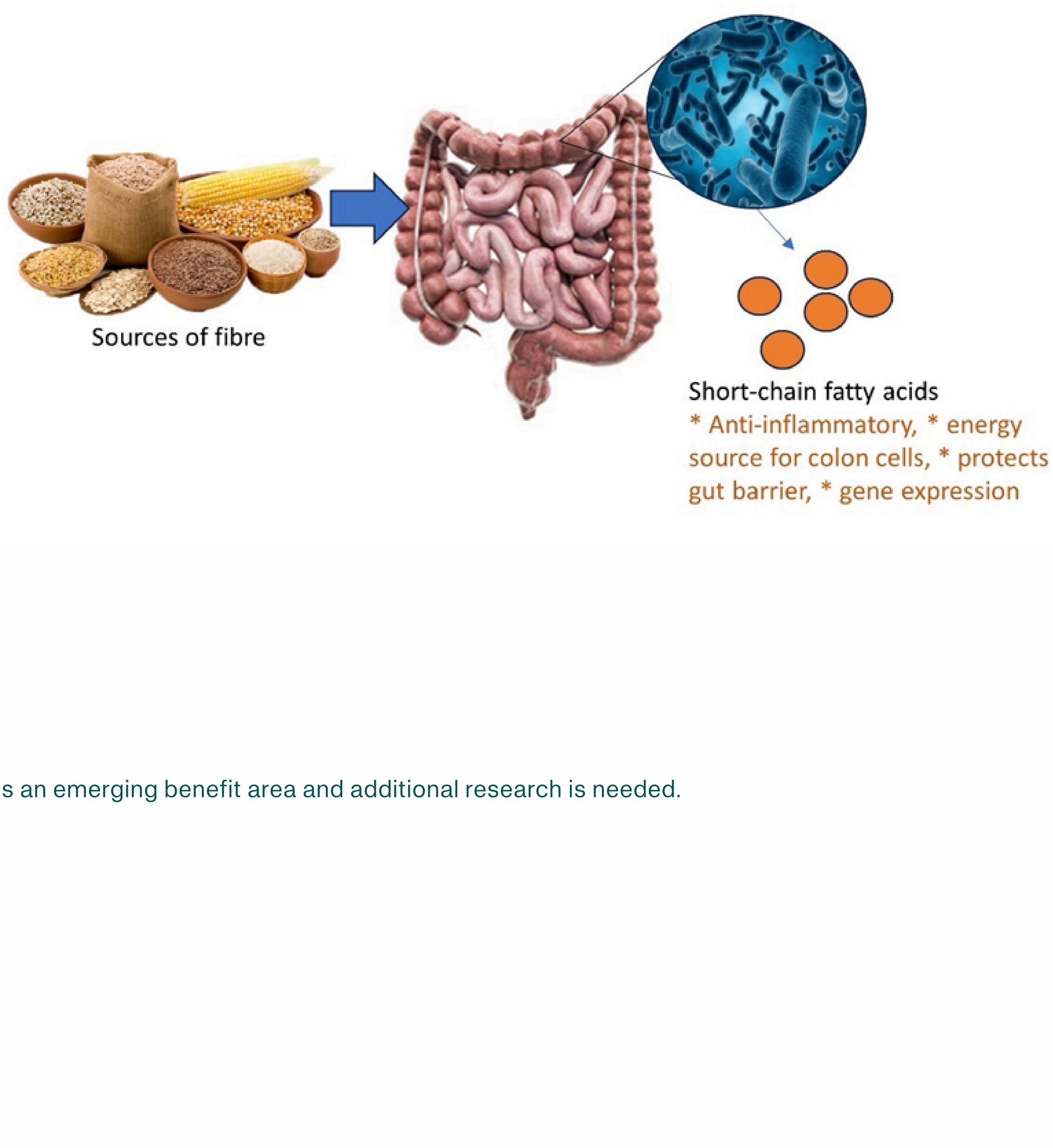
Key: RCT, randomised controlled trial

Immune function *

The gut microbiota has emerged as a significant factor in optimal immunity since a well-functioning gut is vital for the body's defences against pathogens and allergenic compounds. The microbiome matures rapidly during the first year of life, although it can be modified – in both a positive and negative way – across the whole lifecycle[57].

High-fibre foods, fibre supplements, polyphenol-rich foods and fermented foods may benefit the gut microbiota by introducing new species, boosting microorganism diversity or providing substrate (food) for desirable species such as *Bifidobacteria*. In contrast, some medical interventions notably antibiotics, can have a negative effect on the gut microbiota by creating an imbalance of species[34].

Figure 3: How fibre could impact on immune function*



*This is an emerging benefit area and additional research is needed.

As shown in Figure 3, and although further research is needed, dietary fibre may support the gut's immune response by feeding beneficial bacteria that break down the fibre in the colon and release short-chain fatty acids (SCFAs)[58].

These metabolites are used for energy by colon cells and have a protective effect on the gut barrier, which helps keep pathogens and allergens out of the body. Short-chain fatty acids also have anti-inflammatory, antioxidant, and anti-carcinogenic effects across the body[58].

Table 7 summarises the limited evidence in this area, with most benefits seen for prebiotic oligosaccharides which are postulated to have their effects by increasing natural killer cells activity[59]. The European Academy of Allergy and Clinical Immunology (EAACI)[60] agrees that fibre impacts on immune regulation and has highlighted the potential for using fibre to promote immune health.

Table 7: Summary of evidence on fibre and immune function in children

Type of study	Age group (years)	Condition studied	Benefit	Reference
Meta-analysis	0-7	Prebiotics and respiratory tract infections	Yes	Williams[59]
Prospective cohort study	8-16	Fibre and allergic rhinitis	Yes	Sdona[61]
RCT	0-2	Prebiotics and allergy or infection	Yes	Arslanoglu[62]

Key: RCT, randomised controlled trial

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Body composition

According to the US Academy of Nutrition and Dietetics, diets that meet or exceed fibre recommendations lower the risk of obesity in adults[63]. This may be due to fibre prolonging the feeling of fullness after eating – called satiety – or beneficial effects on gut microbiota[64]. In children, observational studies provide a mixed picture with studies reporting lower body fat[65] or more normal weight gain[66] when higher fibre diets were consumed. Higher quality studies provided more favourable evidence for fibre but there was a lack of agreement on optimal intakes[2].

Turning to clinical trials, of which there are too few, prebiotic supplementation in overweight children appeared to offer limited benefits for waist-to-height ratio[67], appetite control and energy intakes[68].

Table 8 summarises this evidence which, so far, is insufficient for drawing conclusions about the benefits of fibre for weight management or body composition in children.

Table 8: Summary of evidence on fibre and body composition in children

Type of study	Age group (years)	Condition studied	Benefit	Reference
Review	2–18	Fibre and obesity	Yes	Edwards[38]
Review	N/A	Fibre and obesity	Unclear	Kranz[69]
PCS	12–17	Fibre and body fat	Yes	Gopinath[66]
Observational study	14–18	Fibre and body fat	Yes	Parikh[65]
Review	1–19	Fibre and body weight	Unclear	Reynolds[2]
PCS	0–5	Fibre and obesity	No	Thorsteinsdottir[70]
RCT	8–18	Fibre and body composition	Unclear	Atazadegan[67]
RCT	7–12	Prebiotic and appetite control	Unclear	Hume[68]

Key: RCT, randomised controlled trial

Bone health

Good bone health requires adequate calcium, vitamin D and physical activity. Bone density continues to accrue until a person reaches their early to mid-twenties; hence childhood presents an important window of opportunity to maximise bone nutrient intakes. Yet, calcium intakes in adolescents can fail to reach recommendations, putting generations of adults, mainly women, at risk of later bone fragility[71].

There were concerns that certain fibre-rich foods, e.g., green leafy vegetables and wholegrain cereals, inhibit calcium absorption and could negatively impact bone health but this was determined to be negligible by the European Food Safety Authority[72]. However, increasing fibre could positively impact bone health by boosting mineral absorption in the gut, through effects on the gut microbiota.

A systematic review and meta-analysis reported significant improvements in serum calcium, bone mineral density and height-for-age following interventions with pre and probiotics which modulate the microbiota[73].

Table 9 summarises the evidence.

Table 9: Summary of evidence on fibre and bone health in children

Type of study	Age group (years)	Condition studied	Benefit	Reference
Meta-analysis	N/A	Prebiotics and probiotics and bone development	Yes	Huang[73]
RCT	11-14	Soluble corn fibre and calcium absorption	Yes	Whisner[74]
RCT	9-13	Inulin-type fructans and bone mineralisation	Yes	Abrams[75]
RCT	12-15	Soluble corn fibre and calcium absorption	Yes	Whisner[76]

Key: RCT, randomised controlled trial

The potential role of prebiotic fibres in bone health merits further exploration since the evidence to date reports that they are effective at increasing calcium absorption and bone accrual whilst appearing to be well-tolerated.

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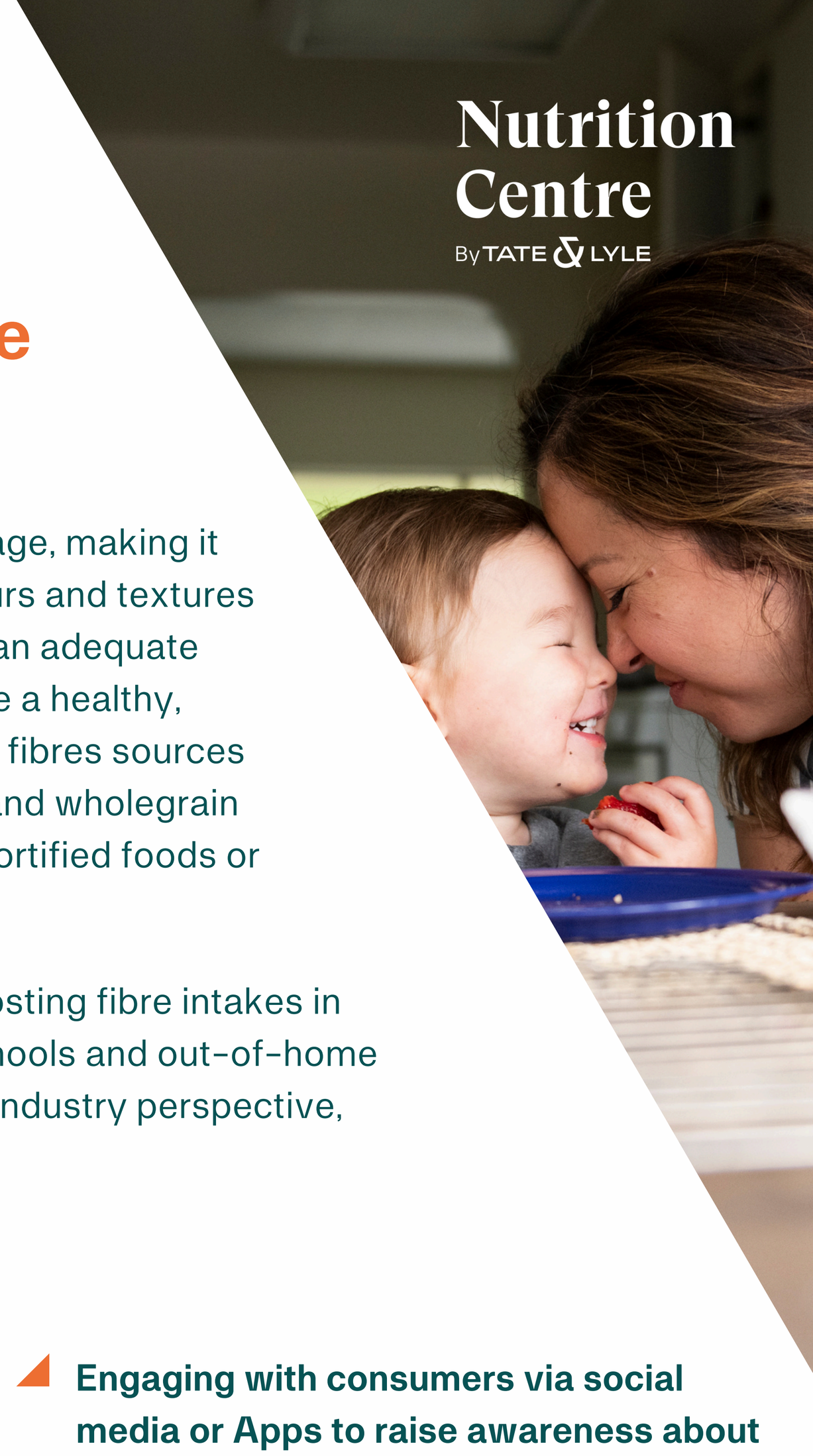

Strategies to boost fibre consumption

Food preferences are established at an early age, making it essential to offer a wide range of foods, flavours and textures to infants and pre-school children. To ensure an adequate fibre intake, the general advice is to encourage a healthy, balanced diet which contains plenty of natural fibres sources such as fruit, vegetables, beans, pulses, nuts and wholegrain cereals. This can be complemented by fibre-fortified foods or supplements.

Families are the most important actors for boosting fibre intakes in children, but food retailers, manufacturers, schools and out-of-home food providers all have roles to play. From an industry perspective, this can include:

- **Reformulating family favourites to boost the fibre content such as adding "hidden" vegetables in sauces and ready meals or by using wholegrain cereals.**
- **Avoiding over processing of fruit to retain the fibre content e.g., adding pulp back to fruit juices or purees;**
- **Signposting fibre content through clear, inspiring labelling, including inclusion of fibre in the nutrition panel even when nutrition claims are not possible;**
- **Considering a multi-fibre approach as demonstrated by an intervention study which found gut microbiota benefits for yoghurt fortified with high amylose resistant starch, polydextrose, long-chain inulin and xylooligosaccharides;[79]**
- **Engaging with consumers via social media or Apps to raise awareness about fibre and where to find it in the diet;**
- **Using marketing and advertising to talk about the health benefits of fibre;**
- **New product development using novel fibre ingredients. For example, high amylose wheat flour[77], a source of resistant starch, and citrus fruit fibres[78] can boost the fibre content of grain-based foods while remaining acceptable to consumers;**

Concerns have been raised regarding the safety of including more fibre in the diets of younger children since high fibre diets have a lower energy density and certain types of fibre, such as bran, can inhibit the absorption of some minerals. However, studies of children eating fibre-rich plant-based diets suggest that normal growth and development can be achieved regardless of the level of fibre in the diet[80]. Issues with mineral absorption can be mitigated in some cases by food combinations, such as drinking orange juice with meals based on beans or pulses to boost iron absorption.

Sample menu for children

Higher fibre breakfast cereal and milk and banana

***

Lentil soup and wholegrain roll, fruit

***

Lamb and chickpea stew, wholegrain rice, broccoli

***

Snacks: dried apricots, oatcake and cheese, apple

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10 Tips for families

Vegetables first

Start complementary feeding with vegetables to build tolerance to bitter tastes

Don’t give up

Children may need to try a new higher fibre food 8-10 times before accepting it.

Eat the rainbow

Offer different coloured fruit and vegetables at every meal.

Creativity

Cut vegetables into shapes or letters to tempt fussy eaters.

Mix it up

Don't have the same breakfast every day! Try different types of breads and high fibre cereals.

Make the switch

Swap white bread for half and half, and gradually move to wholegrain bread.

Add interest

Chuck dried fruit into porridge or mix up a salad pot with colourful vegetables and seeds.

Bean feast

Add a handful of canned lentils or beans to stews, casseroles, curries or chilli.

Make snacks count

Try offering chunks of peppers, baby tomatoes, plain popcorn, trail mix, vegetable sticks with hummus, baked potato wedges with cheese, or oatcakes with peanut butter.

Drink up

Don't forget that higher fibre diets need plenty of fluid. Water is the best option.

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The role of fibre fortification and enrichment

It's clear, given the low adherence to fibre recommendations across all age groups and most countries, that eating a high fibre diet is difficult for consumers. Fibre-fortified foods can help boost fibre intakes whilst providing potential public health benefits, such as reduction in cardiovascular and type 2 diabetes risk in the UK[81] and China[82].

A health modeling and nutrition study found that reformulating everyday foods with added fiber could more than double the number of children in the UK meeting their recommended fiber intake.[81]

Useful ingredients include inulin, wheat bran, barley bran, beta-glucans, oligofructose, soluble corn fibre, resistant starch, high-amylose wheat flour and psyllium husk.

Many innovations are still relatively new and are not yet used widely across the children's food market, but research suggests there are benefits to consumers, and taste and texture remain within the vital zone of consumer acceptability. Adding fibre to favourite foods and beverages can be particularly valuable where a child has allergies or intolerances, is a fussy eater or has a poor appetite.

The ingredients list gives at-a-glance information about everything contained in a packaged food or beverage. Technical terminology may be used for added fibres as defined by national regulatory authorities but these are typically unfamiliar to consumers. For example, polydextrose is the technical name for a type of dietary fibre commonly used in foods and beverages. Another is methylcellulose, synthesised from cellulose and resistant maltodextrin, extracted from corn starch again, a type of dietary fibre with prebiotic properties.

The trend for 'clean labels' amongst certain groups of consumers could act as a barrier to the uptake of novel fibre ingredients, which may sound too 'chemical'. However, working closely with regulatory and public health bodies can help manufacturers and retailers improve consumers' understanding and acceptability of fibre ingredients. Ultimately, by getting more fibre into their diet, consumers can benefit their health.

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Tolerating added fibre

Fibre is undoubtedly beneficial to health perceptions around tolerance could act as a barrier. Media stories abound of people experiencing gas, bloating or diarrhoea when eating fibre-rich foods, but the issue may be 'too much too soon' as most intervention studies report good tolerance. The less desirable effects of boosting fibre consumption are typically due to rapid fermentation and binding with water in the large intestine. Gradual changes to fibre intake over time are less likely to lead to episodes of digestive distress. Some fibres are better tolerated than others.

Research in children is limited. One study in 44 children aged 3-9 years old found that moderate intakes of soluble corn fibre (3-8g/day for 10 days) were well tolerated and were comparable to inulin.
Additionally, the study showed that soluble corn fibre was better than inulin in terms of gas production effects[41] .The scientists proposed that fortification of either fibre ingredient at a level of 6-8g per day could help address the fibre gap without risking gastrointestinal discomfort.

Tolerance may be better in children than in adults. One study found mild gastrointestinal effects at inulin intakes of 10-15g per day in adults but 7–12-year-olds tolerated 8g/day[69]. In another study, adolescents experienced good tolerance for soluble corn fibre at intakes up to 12g[76]. Current evidence suggests that dietary fibre from foods or synthetic sources is well-tolerated by healthy children as long as fibre is introduced gradually[41,69] . This provides some confidence in the potential of ingredients to increase fibre intakes and close the fibre gap.

Conclusions

- Dietary fibres from a range of intrinsic, extracted and synthetic sources have the potential to benefit children's health as well as tracking into adult health.

- Emerging evidence suggests additional benefits to bone density, cardiovascular health and glycaemic control but further research is needed to determine if fibre is helpful for bowel health/function, and maintenance of healthy body weight.

- Evidence from studies across many countries shows that current intakes of dietary fibre amongst children are far too low compared with recommendations. There is a persistent fibre gap which needs addressing through public health policies as well as action by the food industry.

- New ways to increase fibre intakes in children are needed. Dietary strategies can include advocating simple food choices through innovations by the food industry to increase the fibre content of foods consumed by children via fortification and supplementation with novel and extracted dietary fibres. Work also needs to be done to signpost and promote high fibre food and beverage products to consumers.

Likely to be beneficial

- Inflammatory bowel disease & synbiotics
- Gastroenteritis & prebiotics
- Antibiotic treatment & prebiotics
- Metabolic syndrome & fibre
- Insulin resistance & soluble fibre
- Serum cholesterol & fibre
- Allergic rhinitis & fibre
- Allergy & prebiotics
- Respiratory tract infections & prebiotics
- Bone mineralisation & prebiotics
- Calcium absorption & prebiotics

Insufficient or mixed evidence

- Constipation & fibre
- Functional abdominal pain & fibre
- Insulin resistance & fibre
- Immune disorders & fibre
- Obesity & fibre
- Body composition & fibre

Figure 4: Overall summary of the evidence for fibre benefits in children

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