

Review Article,

Review on the Role and Recommendation for Dietary Fibers in Childhood Constipation

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Introduction to Fibers:

The plant material in the diet that is resistant to enzymatic digestion is defined as “dietary fibre”. The primary ingredients that are classified as dietary fibres are cellulose, hemicellulose, pectic substances, gums, mucilages and lignin etc. Dietary fibre naturally exist in foods that are consumed daily viz., cereals, fruits, vegetables and nuts. The diets with high content of fibre have shown benefits in multiple areas and systems in maintaining a milieu³-interior. Processing of foods leads to various changes in physical, chemical, enzymatic and thermal treatments, which may affect the composition of total fiber present in the diet. Fibres included in the diet leads to various changes in the qualitative aspects of the food that is processed. Favourable outcomes have been reported in various commodities such as cereals, bread, yoghurt and beverages. The importance and the uses of fibres in diet is an area of constant interest which needs to be explored further and our paper reviews and explains the relation between dietary fibres and their benefits, primarily in children [1].

The universally accepted definition of dietary fibers “Dietary fiber is a type of carbohydrate that cannot be digested by our bodies enzymes”. The current definition of dietary fiber “Dietary fiber is the remnants of the edible part of plants and analogous carbohydrates that are resistant to digestion and absorption in the human small intestine with complete or partial fermentation in the human large intestine” [2,3]

Fiber is a very important non-nutrient. Foods rich in fiber improves satiety as it needs more clearing than other foods and it absorbs water and swells in the stomach and gives a feeling of fullness. [4]

The types of fiber that are known are

- Soluble fiber
- Insoluble fiber

Fibers have played an important role in the diet of our civilization and finds an inevitable role in all

civilizations and all ages. The Indus, Aryan, Iron, Bronze, Neolithic all have quotes and food patterns where dietary fibers find a significant role in the diet. The chart below quotes the role of fibers and documentation in the past eras. [Table 1]

Metabolism of Fibers:

Dietary consumption of carbohydrates consists of absorbable and non-absorbable sugars. The absorbed sugars undergo a different pathway which involves the amylase (pancreatic enzyme) for digestion and conversion in the small intestine. [5,6]

- The non-digestible fibers include Cellulose, fructose, Starch, xylose, Gums, pectin. These fibers are fermented by colonic bacteria and they get converted to: Butyrate, Propionate, Acetate, Carbon-dioxide which gets converted to Hydrogen.

- Where SCFA (Short chain fatty acids) are formed and it leads to the absorption by the colonic epithelial cells.

Table 1. Agricultural crops in Vindhyan region as revealed by archaeological studies and the prebiotic precursor content

Crop	Available since (Pokharia ¹⁵)	Fraction contributing prebiotics action/ prebiotics precursor
Cultivated rice	Neolithic	Arabinoxylan
Hulled barley	Neolithic	Arabinoxylan and glucan
Bread wheat	Neolithic	Arabinoxylan, resistant starch
Dwarf wheat	Neolithic	Arabinoxylan, resistant starch
Ragi millet	Neolithic	Arabinoxylan
Lentil	Neolithic	Resistant starch, galactosides
Field pea	Neolithic	Resistant starch
Chick pea	Neo and Chalcolithic	Resistant starch
Horse gram	Chalcolithic	Resistant starch
Green gram	Neolithic	Resistant starch
Black gram	Neolithic	Resistant starch
Cow pea	Early Iron Age	Resistant starch
Moth bean	Chalcolithic	Resistant starch
Pigeon pea	Neolithic	α-Galactosides
Onion	Early Iron Age	Oligofructose and inulin
Garlic	Late Iron Age (AD 300)	Inulin

Let’s see an example of a food that is believed to “cure” or “treat” constipation in the Indian sub-continent: Banana. Banana is not digested by the small intestine and escapes the “digestion” by Amylase resistant starch and is directly delivered to the colon which leads to formation of ‘SCFA’ and also gives a trophic effect, with increased absorption of Increase salt, water absorption, Provides energy[7,8]

Below are well known benefits of dietary fibers:

- Normalizes bowel movements
- Bowel health
 - Decreases risk of developing hemorrhoids
 - Decreases production of diverticula (diverticulosis)
- Lowers Cholesterol
 - VLDL (Very low density lipoprotein)
- May reduce blood pressure and inflammation
- Improves blood sugar due to soluble fibers (Helps in achieving better Glycaemic control)
- Reduce the risk of developing type 2 diabetes

- **Insoluble fibers**
- Helps in reducing weight
- Less caloric dense
- Prevents colorectal cancer.

Functions and benefits of dietary fibre on human health [Table 2 & 3]

The Current recommendations for fibers in pediatrics- a review

The current food era focusses on “balanced” diet and fiber has become an essential nutrient in all consumer foods including beverages and oral nutrition supplements. Recommendations for dietary fibers have been published by multiple world bodies including American dietetic association [6], Indian dietetic association (IDA)[7], Indian council of medical research (ICMR) among others. Although multiple guidelines exist for the use of fiber none of them have recommendations for children. Among the various recommendations for recommended use of fibers in children the following formula is universally accepted

“Age of the child in years + 5 g”

And

“0.5 g fiber/kg body weight/day) up to 35 g/day

Table 2

Functions	Benefits
Adds bulk to the diet, making feel full faster	May reduce appetite
Attracts water and turns to gel during digestion, trapping carbohydrates and slowing absorption of glucose	Lowers variance in blood sugar levels
Lowers total and LDL cholesterol	Reduces risk of heart disease
Regulates blood pressure	May reduce onset risk or symptoms of metabolic syndrome and diabetes
Speeds the passage of foods through the digestive system	Facilitates regularity
Adds bulk to stool	Alleviates constipation
Balances intestinal pH and stimulates intestinal fermentation production of short-chain fatty acids	May reduce risk of colorectal cancers

Functions and benefits of dietary fibre on human health [Table 2][3]

TABLE 3:

Age	Fiber (grams/day)
1-3 years	
Male	19
Female	25
4-8 years	
Male	25
Female	31
9-13 years	
Male	31
Female	26
14-18 Years	
Male	38
Female	29

Scientific evidence for fibers in constipation

The following causes are attributed to childhood constipation

Poor Lifestyle

- Sedentary Lifestyle
- Less physical activity
- Chronic stress
- Lack of sleep

Unhealthy Eating Habits

- Junk foods rich in refined white flour, sugar, saturated fats
- Irregular meal timing
- Less intake of fluids
- Skipping meals or Overeating
- Over consumption of dairy products

Others

- Excessive use of certain Antibiotics and Medicines

Multiple studies have emphasized the role of fibers primarily in childhood constipation and various functional gastrointestinal disorders.

- There is existing evidence to suggest that fiber is more effective than [10,11]
 - Probiotics
 - Placebo
 - Laxatives
 - Drugs

In the management of paediatric constipation along with diet, adequate water intake and drugs (as age appropriate), Various studies have shown that fiber improves stool frequency or improve stool consistency, successful treatment outcomes, drug use and painful passage of stools [10,11]. The usage of fibers in the safety and management of childhood constipation in increasing the Gut transit time and promoting regular evacuation have been documented in several studies but non-existence of Randomized controlled studies, particularly in the usage of isolated non-pharmacological treatment in the management of paediatric constipation lack. The commonly used fibers in the management of constipation are:

- Cocoa husk
- Glucomannan
- Ispaghula

A small sample, double-blind, randomized, crossover study done by Loening-Baucke et al [12]

Constipation flow chart

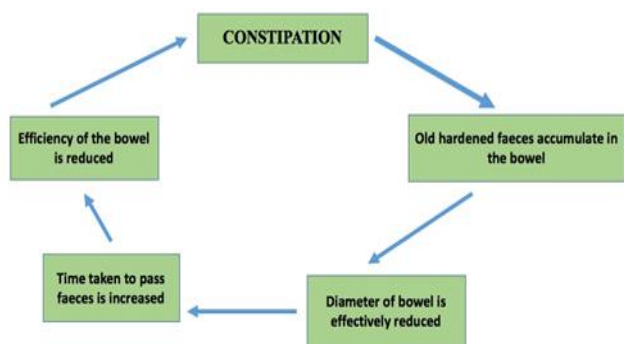


Table 4:

Age Group	Total water intake per day, including water contained in food	Water obtained from drinks per day
Infants 0-6 months	700 ml assumed to be from breast milk	
7-12 months	800 ml from milk and complementary foods and beverages	600 ml
1-3 years	1300 ml	900 ml
4-8 years	1700 ml	1200 ml
Boys 9-13 years	2400 ml	1800 ml
Girls 9-13 years	2100 ml	1600 ml
Boys 14-18 years	3300 ml	2600 ml
Girls 14-18 years	2300 ml	1800 ml

Recommended water intake for children
TABLE 4

Daily Recommended Intake of Fiber by Age and Gender (age+5 formulas)

TABLE 3

Recommended water intake for children[8,9]

TABLE 4

showed that the addition of fibres in children with chronic constipation with or without encopresis showed benefit on adding fibre (glucomannan) in this cohort irrespective of whether they are on laxatives or not.

Dietary fibres and colonic transit time

A double blind randomized controlled study done by Castellijo and colleagues in 2006 showed an improvement in colonic transit time especially in the left colon to rectum when cocoa husk was added in the treatment plan. Children who had cocoa husk showed increased bowel frequency and more formed stools with no reported adverse events [13].

Diet and Fibers

The following are examples of foods that are rich in fiber

- Whole cereals like whole wheat, barley, ragi, oatmeal etc.
- Legumes and germinated pulses like rajma, channa etc
- Green leafy vegetables like spinach, cabbage, lettuce etc.
- Salads and boiled vegetables (Cauliflower, Broccoli, Capsicum)
- Fruits with skin e.g. Apple, guava, pears

Sample High fibre is given below for various meals of the day (primarily for Indian Children)

Breakfast

North Indian

- Pulkas (2) / Chapatis (2) / Veg. Poha (1 cup) / Quinoa (1 cup)
- Dhal / Cooked vegetable preparation- 1 cup
- Tomato / Onion / Dhal Chutney / mint / Coriander chutney (No Coconut / Groundnut) -1 cup (or)

Continental

- Brown Bread / Multi-grain Toast /Veg s/w -2 slices (½tsp Jam)
- (or)
- Thick Oats / Wheat Porridge/ Muesli -1½ cup+/- (½tsp sugar)

Mid-morning snack

- 1030 am-Vegetable Soup- 1 cup (add salt to taste)
- Digestive Marie / Marie Biscuits-2-3 nos.

Lunch sample menu

- Chapati/Rice-(½ cup Rice = 1 Chapati) -2 (no's) or / 1 cup
- Dhal / Sambar -1 cup
- Vegetable Curry / Subji -1- 2 cups
- Vegetable – Kootu or Poriyal-1-2 cups
- Salad / Boiled Vegetables -1- 2 cups
- Curd-1 cup

Snack sample menu

- 0400 pm-Fruits- 200 grams

Tea time

- Tea / Coffee / Milk-100 ml
- ½ tsp- sugar
- Sundal (channa) / Boiled gram / Boiled Corn- ¾ cup

Dinner sample menu

- Same as Breakfast / Lunch
- Flaxseed – 2 tablespoons

* Note: For reference:

- 1 cup = 150 ml capacity
- 1 glass = 200 ml capacity
- 1 teaspoon = 5 gm

Conclusion:

The use of dietary fibers in clinical practice is expanding and the clinician has been enriched in the wider uses are yet to be discovered. The use of dietary fibers cannot be ruled out and they are here to stay for long term. Dietary fibers are safe with few or no side effects and they form a vital role in non-pharmacological treatment. Safety of fiber along with adequate fluid intake and minimal pharmacological therapy will help in resolving childhood constipation.

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