**PROPOSITION OF DIET IN CONSTIPATION**

**Kakara Divya\*1, Mercy Rickets Dubburu1, Ramesh Malothu1**

*1School of Biotechnology, Jawaharlal Nehru Technological University Kakinada, Kakinada, AP, India - 533003*

**\*Corresponding Author:**

**Kakara Divya**

**Assistant Professor**

**School of Biotechnology**

**Jawaharlal Nehru Technological University Kakinada**

[**kakaradivya38@gmail.com**](mailto:kakaradivya38@gmail.com)

**Abstract:**

Constipation is a common gastrointestinal condition which is now increasing enormously.Chronic constipation (CC) is characterized to be a common issue caused with a irregular bowel movement or difficulty in feces passage. It is presented by many forms with varied symptoms. Genetic predisposition, Type of diet, social economic status, absorption, daily behaviors, colonic motility, pharmaceutical and biological factors are the variables that contribute to the development of the disease. Diagnostic and therapeutic options are crucial in management of CC. Dietary fiber has been recommended as a step in the management of CC since it plays a significant role in this condition.

**Keywords:** CC, Nutrition, Physical activity, Fiber.

**1. Introduction:**

Constipation is characterized by the decrease in frequency of bowel movementsor increased difficulty in process of eliminating stool [1,2]**.** CC is a prevalent gastro-intestinal (GI) condition presented to surgeons, subspecialty physicians and primary-care physicians globally [3,4]. Worldwide, the constipation prevalence rate was estimated to be 16% [5]. In India, the Gut Health Survey results imply that 22% adults are complaining of CC [6] and 13% people with severe constipation and 6% suffers from constipation associated with certain co-morbidities [6]. The co-morbidities include Irritable bowel syndrome, gastro oesophageal reflux disease, depression, anxiety, dyspepsia, etc. Constipation is often associated with nausea, infrequent bowel movements bloating, [7] and abdominal pain (mild to severe), loss of appetite, infrequent bowel movements, hard stools, excessive straining [7]. CC was more prevalent in the elder people i.e., 50-70% [2].

Constipation is classified into acute and chronic based on duration of problem. Acute constipation is a type which lasts less than one week. Chronic constipation lasts for more than 4 weeks or more than months (consensus criteria) [8].

**Diagnostic Criteria for Functional Constipation:**

The functional constipation diagnosis criteria according to Rome III include- “1. Including two or more of the Criteria:(a) Straining for more than 25% of defecations, (b) Lumpy or hard stools (Stool Type 1, 2) [86] more than 25% of defecations, (c) Sensation of incomplete evacuation more than 25% of defecations, (d) Sensation of anorectal obstruction/ blockage more than 25% of defecations, (e) Manual maneuvers to facilitate more than 25% of defecations, (f) Fewer than 3 spontaneous bowel movements per week; 2. Loose stools are rarely present without the use of laxatives; 3. Insufficient criteria for irritable bowel syndrome: Criteria fulfilled for the last 3 months with symptom onset at least 6 months prior to diagnosis” [8,9]**.**

Primary chronic constipation is a type of CC without unknown cause. This can be of “improper bowel function due to dietary factors (insufficient fiber intake), lifestyle factors (lack of mobility or sedentary lifestyle) or a disorder of colonic propulsion or rectal emptying” [10].

Secondary chronic constipation results from treatment for organic diseases (opioids or antihypertensive agents), systemic diseases (hypothyroidism or Parkinson’s disease), local pathology in the colon related disorders (colon cancer or diverticular structure)” [10]

There are 3 types of primary chronic constipation- rectal evacuation disorders (outlet delay disorders or dyssynergic defecation), slow transit constipation (colonic inertia or chronic colonic pseudo obstruction) and normal transit constipation (functional constipation). The rectal evacuation disorders include lack of coordination in pelvic and abdominal muscles to evacuate feces (either by structural and functional defects); slow transit constipation include delayed movement of stool in the colon due to abnormalities in the pelvic and anal sphincter muscles; normal transit constipation due to unidentifiable biochemical or structural cause. This type overlaps irritable-bowel-syndrome (IBS).

Slow transit constipation responds to dietary changes. Increased intake of water and fiber hydrates the feces that hasten intestinal transit. On the contrary, dietary changes could not affect the dyssynergic defecation and could only improve stool consistency. The pelvic floor rehabilitation can be an effective therapy [11]. This type was more frequently observed in women [10,12].

Genetic predisposition plays a major role in functional constipation with positive family history of constipation [13]. Constipation is generally functional in origin and rarely a cause of organic aetiologies in >95% cases. Organic aetiologies include metabolic and endocrine factors, anorectal factors, neuropathic factors, and intestinal factors. Psychological disorders, lifestyle factors and genetic factors are the prevalent pathophysiological factors [13,14]. The age positively correlates with the onset of CC [15]. The CC is most commonly observed in women compared to men [15-17], whilst this correlation is not observed in children [19] and elders [10,18].

**2. Nutrition:**

The alimentary and functional CC can be treated by diet therapy. Besides these, the diet therapy also treats CC with organic origin [20]. The diet and fluid intake play an important role in improving functional constipation.High water intake and high fiber are affirmed to reduce risk of constipation among people aged 65 years and younger, but not significant among > 65 years [2].

**2.1 Minerals:**

The micro minerals like selenium and magnesium were considered essential to reduce chronic constipation (especially in children) [21]. Selenium is nutritionally essential trace element which is naturally present in many foods. This has wide range of physiological functions including antioxidant defense and anti-inflammatory effects and the recommended intake is 55μg/day for a normal adult and 60-70 μg/day for pregnant women [22,23]. Magnesium is 4th most abundant cation in the human body that acts as cofactor for more than 600 enzymes [24].

Magnesium salts such as magnesium sulfate have been used as a laxative in the treatment of constipation for their osmotic effects due to their incomplete absorption in the GI tract [25,26]. This effect has decreased the prevalence in a quartile of men [27,28]. Stool frequency was also inversely associated with constipation with the intake of magnesium. The natural mineral water rich in magnesium sulfate showed improved bowel movement frequency and stool consistency in functional constipation subjects [29,30]. Magnesium oxide also effectively treats constipation [31]. Magnesium acts as a mild laxative in the form of sulfates or citrate salts. These help in fluid retention and motility in digestive tract. Mg/Zn also play a major role in relieving constipation [42,43].

**2.2 Fiber:**

Men aged 19 to 50 should consume 38 grammes of protein per day, while women should consume 25 grammes. Men over the age of 51 should consume 31 grammes of protein per day, while women over the age of 51 should consume 21 grammes per day. For children ages 1-3, 19 g/day is advised, and for those ages 4–8, 25 g/day. The DRI guidelines for boys are 31 g/day for those aged 9 to 13 and 38 g/day for those aged 14 to 18. The DRI recommendations are 26 g/day for girls ages 9 to 18 [32,33].

Dietary fiber is of two types- soluble and insoluble fiber. Pectins, gums, and certain hemicelluloses make up soluble fibres, which can be found in foods like oats, apples, bananas, barley, beans, and barley [8]. Bulk is added to stools by soluble fibre [44]. Cellulose, lignin, and certain hemicelluloses are the main components of insoluble fibres, which do not dissolve in water. Foods including wheat bran, all fruits and vegetables, and entire grains contain it. It is sometimes referred to as roughage or bulk because it maintains regular digestion, lowers the risk of colon cancer, and helps relieve constipation and haemorrhoids [40]. Insoluble fibre facilitates the passage of food through the digestive system and aids in the avoidance of constipation [44]. Through mechanical stimulation of the gut mucosa, which causes secretion and peristalsis and has a considerable laxative effect, it raises the faecal bulk and colonic transit rate [8]. The majority of fiber-rich meals contain roughly a third soluble and a second-third insoluble fibre [45,46].

The type of stools the patient was passing were determined using the Bristol stool scale, which divides stools into 7 groups. According to the Bristol stool scale, the seven kinds of stools were divided into: Sort out hard lumps, such as nuts, that are difficult to pass; Type 2: Shaped like a sausage but bumpy; Type 3: Looks like a sausage but has surface cracks; Type 4: Smooth and soft, like a sausage or a snake; Type 5: Soft blobs with sharp edges that easily passed; Type 6: A stool made of squishy sections with rough edges; Type 7: Watery with no firm pieces. 100% liquid [86].

Glucans that are polymers of three or more monomeric units and are neither digested or absorbed in the small intestine are collectively referred to as fibre, along with lignins [62]. Fibre consists of a variety of molecules with different solubilities, viscosities, and fermentabilities [63]. Both viscous and non-viscous fibres are effective at bulking up stools because they both reach the lower gut in an undamaged state [64]. The luminal sac is further dilated and peristalsis is induced by an increase in stool bulk [65]. Fermentable fibres boost short-chain fatty acid (SCFA) synthesis and gut bacteria diversity, which increases faecal biomass. The increased colonic osmotic load that follows increases the water content of the faeces, making the stools softer [66].

Fiber can be further divided into:

- “Soluble, viscous, fermentable (e.g., Guar gum) [44]

- Soluble, viscous, unfermentable (e.g., Psyllium, HPMC—Hydroxypropyl methylcellulose)

- Soluble, non-viscous, fermentable (e.g., Inulin [44], FOS, GOS, Pectin)

- Soluble, non-viscous, unfermentable (e.g., PHGG—Partially Hydrolyzed Guar Gum)

- Insoluble and slowly fermentable (e.g., Wheat bran [44], Resistant starch, Whole grains)

- Insoluble and unfermentable (e.g., Cellulose, Lignin)”

In order to normalise stool consistency in constipation, soluble viscous fibre exhibits a high gel-forming capability that is preserved throughout the large bowel and undergoes minimal fermentation. Because it has a softening impact on the stool, stool water content has a strong correlation with stool consistency. Through mechanical stimulation of the gut mucosa, insoluble fibre increases the faecal bulk and colonic transit rate while having a laxative effect [45].

The Dietary Guidelines for Americans strongly advise eating foods high in nutrients, like whole grains. In order to boost dietary fibre, ensure appropriate GI function, and prevent chronic diseases in both children and adults, at least half of all grains are consumed. An ounce-equivalent serving of whole grain is equal to five whole-grain crackers, one-half cup of cooked whole-grain pasta, rice, or oatmeal, one slice of whole-wheat bread, and three cups of popped popcorn [33].

Wheatbran [44, 47], glucomannan (nonabsorbable fiber) [44], psyllium, or ispaghula (bulk-forming fiber) with water holding abilities [47,48], polydextrose, inulin, galactooligosaccharides [49], cellulose, guar gum were commonly used for the treatment of constipation [44,47]. While a low-fiber diet causes constipation, a high-fiber diet can increase stool weight and shorten colon transit time [50]. Young women who consumed more rice and coffee had lower rates of constipation [51]. Combining clarified butter and jiggery can also help with constipation [69].

**2.2.1 Fatty acids:**

Constipation was directly linked to dietary intake of high saturated fat, but the relationship between dietary unsaturated fat and constipation was the opposite [2]. Among participants who were physically active, dietary fibre intake was linked to constipation related to stool consistency but not significantly to stool frequency [33,34]. In order to delay the development of constipation, the WHO advises consuming 25 to 40 grammes of high dietary fibre per day [35]. High levels of lignans, linoleic acid, and alpha-linolenic acid can be found in flaxseed (Linum usitatissimum). It is an excellent source of soluble and insoluble fibre, which is useful for treating constipation [36]. The diversity of gut bacteria was raised by consuming 9 g of omega-3 unsaturated fatty acids daily from perilla oil for 8 weeks [37]. Constipation was relieved as a result of the favourable correlation between the diversity of the gut microbiota and blood levels of omega-3 unsaturated fatty acids [38].

**2.2.2 Mushrooms:**

Chitin, a straight-chain (14)-linked polymer of N-acetyl-glucosamine, and polysaccharides such as (13)-D-glucans and mannans, respectively, are both found in the fibrillar and matrix components of mushroom cell walls [40]. Beta-glucan, the fibre present in mushrooms, is comparable to the major fibre in goods made from oats. Beta-glucans relieve constipation and intestinal peristalsis. It is also advantageous for controlling blood sugar and cholesterol levels. In addition, mushrooms offer extra nutrients such selenium, copper, and potassium as well as the B vitamins pantothenic acid, riboflavin, and niacin [40, 41].

Mushrooms have been used for treating constipation [55]. A. auricula (black ear mushroom) has high water absorption and water holding capacity and also exhibit high antioxidant activity [52,53]. The phenolic compounds present in mushrooms will minimise the risks of free radicals [40]. The cloud ear mushrooms ([Auricularia polytricha](https://books.google.com/books?hl=en&lr=&id=ZR-pEAAAQBAJ&oi=fnd&pg=PT97&dq=ear+mushrooms+and+constipation+2023&ots=--FQAQV5PD&sig=4W3zHvWlZWrNYJdsF53BXWtVPyI)) significantly improve constipation related symptoms [54,55,82]. The mushrooms like Boletus edulis, *Flammulina velutipes* [57] have increased the propulsion rate of the small intestine [56]

**2.2.3 Fruits:**

Several fruits are great sources of dietary fibre in their fresh, dried, or juiced forms. Fruits with high fibre content are good for the GI tract [49]. A prune (dry plum) boosts peristaltic and gastrointestinal motility [58, 59]. It does not affect faecal water, only faecal bulk [61]. In adult clinical research, fruits including the polyphenol-rich mango, papaya, and green kiwifruit dramatically increase faeces frequency, volume, softness, and comfort. A natural laxative called Ficus carica (fig) increases the frequency of faeces [49].

The regularity of the stools and the intensity of the symptoms serve as indicators of intestinal health. It was discovered that the mango fruit supplementation was more successful at modifying these parameters [60]. Both fibre and sorbitol are abundant in apricots. Increased faecal weight, lipid content, and relative abundances of Bacteroides and Clostridium cluster IV are all provided. Gut transit time was sped up by kiwifruit, fig paste, and trifoliate orange extract powder in addition to apple fibre isolation. The only fruit that has been shown to raise human faecal and small bowel water content is the kiwifruit. In humans, raisins, prunes, and apple fibre isolate all increased faecal weight [61].

The primary components of fruits and fruit products that mediate the effects of fruits on gut microbiota, gut motility, and gut function [61] and consequently affect constipation are fibre, sorbitol, and polyphenols (Figure 1). Fruits, vegetables, cereals, tea, coffee, and wine are just a few examples of the many plant-based meals and beverages that include sorbitol (sugar alcohol) and polyphenols [67,68].

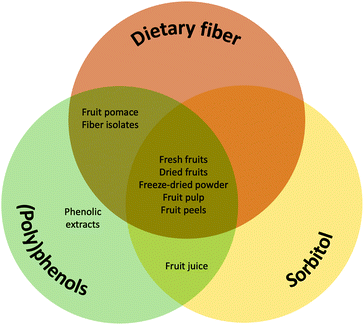


Figure 1: Main constituents in Fruits and fruit products

**2.2.4 Probiotics:**

CC patients showed improved defecation with the use of probiotics and fermented milk [36, 49], feces frequency, increased responsiveness to treatment, integrative symptoms and severity of incomplete evacuation. The use of *B. lactis* showed improvement in stool frequency and use of *“B. coagulans*  Unique IS2” for abdominal pain and defecation pain. For people who encounter negative effects from conventional therapy choices like fibre and laxatives, probiotics can be a great alternative. The probiotics would relieve constipation[70].

In animal model studies, Treatment with yoghurt dramatically reduced constipation-related symptoms and altered the microbiome. Additionally, yoghurt helped mice with antibiotic-induced constipation feel better and somewhat repaired their gut microbiota [71].

**Table 1: List of Various foods with available dietary fiber content**

|  |  |  |  |
| --- | --- | --- | --- |
| **Food** | **Type** | **Fiber/100g** | **Reference** |
| Wheat bran | Grain | 42.8 g | 47 |
| Oat Meal | Grain | 10.6 g | 83 |
| Rye flour | Grain | 12.9 | 83 |
| Psyllium, or ispaghula | Seed | 70g | 48 |
| Guar gum | Seed | 90g | 49 |
| Flaxseed (Linum usitatissimum) | Seed | 26.6g | 36 |
| Prune | Fruit | 6.1g | 58 |
| Apple | Fruit | 16.7 | 85 |
| Banana | Fruit | 10.1 |
| Cherries | Fruit | 8.7 |
| Grapefruit | Fruit | 14.5 |
| Orange | Fruit | 18g |
| Peach | Fruit | 16.1 |
| Pineapple | Fruit | 13.6 |
| Strawberry | Fruit | 31.6 |
| Watermelon | Fruit | 6.4 |
| Pear | Fruit | 21.2 |
| Mango | Fruit | 9.4g | 49, 60 |
| Papaya | Fruit | 1.7g | 49 |
| Green kiwifruit | Fruit | 3g | 49 |
| Fig (Ficus carica) | Fruit | 2.9g | 49 |
| Shiitake mushroom | Mushroom | 4.6 | 84 |
| Pleurotus sajor-caju | Mushroom | 48.60 |
| Pleurotus ostreatus | Mushroom | 8.70 |
| Agaricus bisporus | Mushroom | 20.90 |
| Auricularia auricula | Mushroom | 19.80 |
| Calocybe indica | Mushroom | 3.40 |
| Lentinula edodes | Mushroom | 28.80 |
| Flammulina velutipes | Mushroom | 3.70 |
| Volvariella volvacea | Mushroom | 54.80 |
| Dried kidney bean | Seed | 19.6 | 83 |
| Dried cowpea | Seed | 18.4 |
| Dried azuki bean | Seed | 15.3 |
| Dried pea | Seed | 17.4 |
| Dried soybean | Seed | 17.9 |
| Beet root | Vegetable | 26.7 | 85 |
| Broccoli | Vegetable | 34 |
| Cabbage | Vegetable | 30 |
| Carrot | Vegetable | 34.2 |
| XCelery | Vegetable | 29.4 |
| Cucumber | Vegetable | 15.8 |
| Lettuce | Vegetable | 33.3 |
| Sweet corn | Vegetable | 22 |
| Tomato | Vegetable | 20.7 |

**2.3 Fluids:**

Adequate intake i.e for about one and a half litre to two litres of water per day is proposed as the first line treatment in chronic constipation [49]. Daily intake of at least 1.5 to 2 liters of fluid and daily exercise is significant [9]. Insufficient drinking of water causes constipation [72]. Water intake and hydration has decreased constipation [14] in adults and also in children [74]. The water intake and decreased constipation was questionable in older persons and secondary constipation [73]. Functional constipation group were observed to have a considerable low water intake (1200ml) than the non-functional constipation group (1500ml) [42]. Adequate hydration is important for maintaining intestinal motility [42].

**2.4 Physical activity:**

Physical inactivity is considered as treat for onset of CC [75,76]. Light to moderate exercise were coupled to propulsive mass movements in colon. This suggests that physical activity facilitates defecation and the recto-sigmoid or total colonic transit time. It also affects the BMI, constipation complaints, and the quality of life in premenopausal women [77]. In comparision with the normal people, malnourishment persons have higher risk of functional constipation [42, 43].

**3. Conclusion:**

Constipation can be prevented or treated by maintaining balanced diet that contain vegetables, fruits, wholegrain cereals, water intake along with slight moderate physical activity. Eatwell Guide provides the size and recommended type of various foods to consume a wholesome, balanced diet. According to PHE, 2016, it suggests having vegetables and fruits for atleast 5 portions or 400g daily. This contributes to 1/3rd of the food per day which would reduce the non-communicable diseases risk including constipation. This is robustly encouraged by the WHO (2015).

The daily fibre intake for patients with normal-transit or slow-transit constipation should be boosted to 20 to 25 g either by altering diet or by using packaged fibre diets. Osmotic laxatives should be used by patients who do not respond to fibre therapy. Until the stool softens, the osmotic laxative dosage should be adjusted, along with dietary adjustments. Surgery is not always required. Biofeedback could be used to retrain the evacuation process in patients with defecatory problems. Patients with severe defecatory disorders have to use oral laxatives often at high doses that might result in watery diarrhea and other adverse effects. Patients with enough fibre consumption and the use of laxatives to encourage regular bowel movements, additional bouts of faecal impaction should be avoided.

**4. References:**

1. Bardsley, A. (2015). Approaches to managing chronic constipation in older people within the community setting. *British journal of community nursing*, *20*(9), 444-450.
2. Taba Taba Vakili, S., Nezami, B. G., Shetty, A., Chetty, V. K., & Srinivasan, S. (2015). Association of high dietary saturated fat intake and uncontrolled diabetes with constipation: evidence from the National Health and Nutrition Examination Survey. *Neurogastroenterology & Motility*, *27*(10), 1389-1397.
3. Nellesen, D., Chawla, A., Oh, D. L., Weissman, T., Lavins, B. J., & Murray, C. W. (2013). Comorbidities in patients with irritable bowel syndrome with constipation or chronic idiopathic constipation: a review of the literature from the past decade. *Postgraduate Medicine*, *125*(2), 40-50.
4. Peery, A. F., Crockett, S. D., Barritt, A. S., Dellon, E. S., Eluri, S., Gangarosa, L. M., ... & Sandler, R. S. (2015). Burden of gastrointestinal, liver, and pancreatic diseases in the United States. *Gastroenterology*, *149*(7), 1731-1741.
5. Salari, N., Ghasemianrad, M., Ammari-Allahyari, M., Rasoulpoor, S., Shohaimi, S., & Mohammadi, M. (2023). Global prevalence of constipation in older adults: a systematic review and meta-analysis. *Wiener klinische Wochenschrift*, 1-10.
6. Khartode, S., Shinde, K., Sahare, C., Shinde, S., Khartode, C., & Jagtap, N. (2021). Raisins with clarified butter or ghee for the relief of acute and chronic constipation-A Clinical Study. *American Journal of Food Sciences and Nutrition*, *3*(2), 1-15.
7. Chao, H. C., Chen, S. Y., Chen, C. C., Chang, K. W., Kong, M. S., Lai, M. W., & Chiu, C. H. (2008). The impact of constipation on growth in children. *Pediatric research*, *64*(3), 308-311.
8. Bellini, M., Tonarelli, S., Barracca, F., Rettura, F., Pancetti, A., Ceccarelli, L., ... & Rossi, A. (2021). Chronic constipation: is a nutritional approach reasonable?. *Nutrients*, *13*(10), 3386.
9. Cirillo, C., & Capasso, R. (2015). Constipation and botanical medicines: an overview. *Phytotherapy Research*, *29*(10), 1488-1493.
10. Camilleri, M., Ford, A. C., Mawe, G. M., Dinning, P. G., Rao, S. S., Chey, W. D., & Chang, L. (2017). Chronic constipation. *Nature reviews Disease primers*, *3*(1), 1-19.
11. Bellini, M.; Gambaccini, D.; Usai-Satta, P.; De Bortoli, N.; Bertani, L.; Marchi, S.; Stasi, C. Irritable bowel syndrome and chronic constipation: Fact and fiction. World J. Gastroenterol. 2015, 21, 11362–11370.
12. Heidelbaugh, J. J., Stelwagon, M., Miller, S. A., Shea, E. P., & Chey, W. D. (2015). The spectrum of constipation-predominant irritable bowel syndrome and chronic idiopathic constipation: US survey assessing symptoms, care seeking, and disease burden. *The American journal of gastroenterology*, *110*(4), 580.
13. Vriesman, M. H., Koppen, I. J., Camilleri, M., Di Lorenzo, C., & Benninga, M. A. (2020). Management of functional constipation in children and adults. *Nature Reviews Gastroenterology & Hepatology*, *17*(1), 21-39
14. Mounsey, A., Raleigh, M., & Wilson, A. (2015). Management of constipation in older adults. *American family physician*, *92*(6), 500-504.
15. Wilson, P. B. (2020). Associations between physical activity and constipation in adult Americans: Results from the National Health and Nutrition Examination Survey. *Neurogastroenterology & Motility*, *32*(5), e13789.
16. Narayanan, S. P., Anderson, B., & Bharucha, A. E. (2021, April). Sex-and gender-related differences in common functional gastroenterologic disorders. In *Mayo Clinic Proceedings* (Vol. 96, No. 4, pp. 1071-1089).
17. Kim, Y. S., & Kim, N. (2018). Sex-gender differences in irritable bowel syndrome. *Journal of neurogastroenterology and motility*, *24*(4), 544.\
18. Schmidt, F. M. Q., de Gouveia Santos, V. L. C., de Cássia Domansky, R., & Neves, J. M. J. (2016). Constipation: prevalence and associated factors in adults living in Londrina, Southern Brazil. *Gastroenterology Nursing*, *39*(3), 204-211.
19. Lu, P. L., Velasco-Benítez, C. A., & Saps, M. (2017). Sex, age, and prevalence of pediatric irritable bowel syndrome and constipation in Colombia: a population-based study. *Journal of pediatric gastroenterology and nutrition*, *64*(6), e137-e141.\
20. Lazareva, Y. A., Egorov, D. V., & Seliverstov, P. V. (2023). To the question of the role of nutrition in constipation. *Meditsinskaya sestra*, *25*(4), 14-19.
21. Wang, C., Zhang, L., & Li, L. (2021). Association between selenium intake with chronic constipation and chronic diarrhea in adults: findings from the National Health and Nutrition Examination Survey. *Biological Trace Element Research*, *199*(9), 3205-3212.
22. Tanjung, M., Supriatmo, S., Deliana, M., Yudiyanto, A. R., & Sinuhaji, A. B. (2016). Selenium and functional constipation in children. *Paediatrica Indonesiana*, *56*(2), 111-7.
23. Takac, T., Sztrik, A., Babka, B., Keresztesi, E., Prokisch, J., Nagy, A., & Csiki, Z. (2016). Testing of nano-sized elemental selenium-enriched yoghurt in human trials. *sustainable goat breeding and goat farming in central and eastern european countries*, 251.
24. De Baaij, J. H., Hoenderop, J. G., & Bindels, R. J. (2015). Magnesium in man: implications for health and disease. *Physiological reviews*.
25. Dupont, C., & Hébert, G. (2020). Magnesium sulfate-rich natural mineral waters in the treatment of functional constipation–a review. *Nutrients*, *12*(7), 2052.
26. Dupont, C., Constant, F., Imbert, A., Hébert, G., Zourabichvili, O., & Kapel, N. (2019). Time to treatment response of a magnesium-and sulphate-rich natural mineral water in functional constipation. *Nutrition*, *65*, 167-172.
27. Shen, L., Huang, C., Lu, X., Xu, X., Jiang, Z., & Zhu, C. (2019). Lower dietary fibre intake, but not total water consumption, is associated with constipation: a population‐based analysis. *Journal of Human Nutrition and Dietetics*, *32*(4), 422-431.
28. Zhang, L., Du, Z., Li, Z., Yu, F., & Li, L. (2021). Association of dietary magnesium intake with chronic constipation among US adults: Evidence from the National Health and Nutrition Examination Survey. *Food Science & Nutrition*, *9*(12), 6634-6641.
29. Naumann, J., Sadaghiani, C., Alt, F., & Huber, R. (2016). Effects of sulfate-rich mineral water on functional constipation: A double-blind, randomized, placebo-controlled study. *Complementary Medicine Research*, *23*(6), 356-363.
30. Bothe, G., Coh, A., & Auinger, A. (2017). Efficacy and safety of a natural mineral water rich in magnesium and sulphate for bowel function: a double-blind, randomized, placebo-controlled study. *European journal of nutrition*, *56*, 491-499.
31. Mori, H., Tack, J., & Suzuki, H. (2021). Magnesium oxide in constipation. *Nutrients*, *13*(2), 421.
32. Soliman, G. A. (2019). Dietary fiber, atherosclerosis, and cardiovascular disease. *Nutrients*, *11*(5), 1155.
33. Stewart, M. L., & Schroeder, N. M. (2013). Dietary treatments for childhood constipation: efficacy of dietary fiber and whole grains. *Nutrition reviews*, *71*(2), 98-109.
34. Li, Y., Tong, W. D., & Qian, Y. (2021). Effect of physical activity on the association between dietary fiber and constipation: evidence from the national health and nutrition examination survey 2005-2010. *Journal of neurogastroenterology and motility*, *27*(1), 97.
35. Yurtdaş, G., Acar-Tek, N., Akbulut, G., Cemali, Ö., Arslan, N., Beyaz Coşkun, A., & Zengin, F. H. (2020). Risk factors for constipation in adults: a cross-sectional study. *Journal of the American College of Nutrition*, *39*(8), 713-719.
36. Bellini, M.; Tonarelli, S.; Barracca, F.; Morganti, R.; Pancetti, A.; Bertani, L.; de Bortoli, N.; Costa, F.; Mosca, M.; Marchi, S.; et al. A Low-FODMAP Diet for Irritable Bowel Syndrome: Some Answers to the Doubts from a Long-Term Follow-Up. Nutrients 2020, 12, 2360.
37. Manor, O., Dai, C. L., Kornilov, S. A., Smith, B., Price, N. D., Lovejoy, J. C., ... & Magis, A. T. (2020). Health and disease markers correlate with gut microbiome composition across thousands of people. *Nature communications*, *11*(1), 5206.
38. Kawamura, A., & Sugita, M. (2023). Perilla Oil, An Omega-3 Unsaturated Fatty Acid-Rich Oil, Enhances Diversity of Gut Microbiota and May Relieve Constipation in Sedentary Healthy Female: A Nonrandomized Placebo-Controlled Pilot Study. *Dietetics*, *2*(2), 191-202.
39. Kwiatkowska, M., & Krogulska, A. (2021). The significance of the gut microbiome in children with functional constipation. *Advances in Clinical and Experimental Medicine*, *30*(4), 471-480.
40. Kumari, K. (2020). Mushrooms as source of dietary fiber and its medicinal value: A review article. *Journal of Pharmacognosy and Phytochemistry*, *9*(2), 2075-2078.
41. Shea, N., Arendt, E. K., & Gallagher, E. (2012). Dietary fibre and phytochemical characteristics of fruit and vegetable by-products and their recent applications as novel ingredients in food products. *Innovative Food Science & Emerging Technologies*, *16*, 1-10.
42. Dore MP, Pes GM, Bibbò S, Tedde P, Bassotti G. Constipation in the elderly from Northern Sardinia is positively associated with depression, malnutrition and female gender. Scand J Gastroenterol. 2018;53(7):797–802.
43. Yurtdaş Depboylu, G., Acar Tek, N., Akbulut, G., Günel, Z., & Kamanlı, B. (2023). Functional Constipation in Elderly and Related Determinant Risk Factors: Malnutrition and Dietary Intake. *Journal of the American Nutrition Association*, *42*(6), 541-547.
44. Snauwaert, E., Paglialonga, F., Vande Walle, J., Wan, M., Desloovere, A., Polderman, N., & Shroff, R. (2022). The benefits of dietary fiber: the gastrointestinal tract and beyond. *Pediatric Nephrology*, 1-10.
45. Di Rosa, C., Altomare, A., Terrigno, V., Carbone, F., Tack, J., Cicala, M., & Guarino, M. P. L. (2023). Constipation-predominant irritable bowel syndrome (IBS-C): Effects of different nutritional patterns on intestinal dysbiosis and symptoms. *Nutrients*, *15*(7), 1647.
46. Wong, J. M., & Jenkins, D. J. (2007). Carbohydrate digestibility and metabolic effects. *The Journal of nutrition*, *137*(11), 2539S-2546S.
47. Devaraj, R. D., Reddy, C. K., & Xu, B. (2019). Health-promoting effects of konjac glucomannan and its practical applications: A critical review. *International journal of biological macromolecules*, *126*, 273-281.
48. Rao, S. S., Rattanakovit, K., & Patcharatrakul, T. (2016). Diagnosis and management of chronic constipation in adults. *Nature Reviews gastroenterology & hepatology*, *13*(5), 295-305.
49. Axelrod, C. (2018). Comparison of the role of fiber in the treatment of functional constipation in children and adults. *NeuroGastroLatam Rev*, *2*, 149-56.
50. Forootan, M., Bagheri, N., & Darvishi, M. (2018). Chronic constipation: A review of literature. *Medicine*, *97*(20).
51. Sugimoto, M., Murakami, K., Asakura, K., Masayasu, S., & Sasaki, S. (2021). Diet-related greenhouse gas emissions and major food contributors among Japanese adults: Comparison of different calculation methods. *Public health nutrition*, *24*(5), 973-983.
52. Wang, L., Brennan, M. A., Guan, W., Liu, J., Zhao, H., & Brennan, C. S. (2021). Edible mushrooms dietary fibre and antioxidants: Effects on glycaemic load manipulation and their correlations pre-and post-simulated in vitro digestion. *Food Chemistry*, *351*, 129320.
53. Zhao, H., Wang, L., Brennan, M., & Brennan, C. (2022). How does the addition of mushrooms and their dietary fibre affect starchy foods. *Journal of Future Foods*, *2*(1), 18-24.
54. Khan, A. A., Gani, A., Khanday, F. A., & Masoodi, F. A. (2018). Biological and pharmaceutical activities of mushroom β-glucan discussed as a potential functional food ingredient. *Bioactive Carbohydrates and Dietary Fibre*, *16*, 1-13.
55. Hsieh, H. M., & Ju, Y. M. (2018). Medicinal components in Termitomyces mushrooms. *Applied microbiology and biotechnology*, *102*, 4987-4994.
56. Tan, Y., Zeng, N. K., & Xu, B. (2022). Chemical profiles and health-promoting effects of porcini mushroom (Boletus edulis): A narrative review. *Food Chemistry*, *390*, 133199.
57. Xin, X., Zheng, K., Niu, Y., Song, M., & Kang, W. (2018). Effect of Flammulina velutipes (golden needle mushroom, eno-kitake) polysaccharides on constipation. *Open Chemistry*, *16*(1), 155-162.
58. Bae, S. H. (2014). Diets for constipation. *Pediatric gastroenterology, hepatology & nutrition*, *17*(4), 203-208.
59. Wittig-Wells, D., Sapp, P., Higgins, M., Davis, E., Carter, J., & Jacob, A. (2019). Randomized controlled trial of a natural food-based fiber solution to prevent constipation in postoperative spine fusion patients. *Orthopaedic Nursing*, *38*(6), 367-372.
60. Venancio, V. P., Kim, H., Sirven, M. A., Tekwe, C. D., Honvoh, G., Talcott, S. T., & Mertens‐Talcott, S. U. (2018). Polyphenol‐rich Mango (Mangifera indica L.) Ameliorate Functional Constipation Symptoms in Humans beyond Equivalent Amount of Fiber. *Molecular nutrition & food research*, *62*(12), 1701034.
61. Katsirma, Z., Dimidi, E., Rodriguez-Mateos, A., & Whelan, K. (2021). Fruits and their impact on the gut microbiota, gut motility and constipation. *Food & function*, *12*(19), 8850-8866.
62. Scientific Advisory Committee on Nutrition, Carbohydrates and Health, TSO, London, 2015.
63. Gill, S. K., Rossi, M., Bajka, B., & Whelan, K. (2021). Dietary fibre in gastrointestinal health and disease. *Nature Reviews Gastroenterology & Hepatology*, *18*(2), 101-116.
64. Chaplin, M. F. (2003). Fibre and water binding. *Proceedings of the Nutrition Society*, *62*(1), 223-227.
65. Brownlee, I. A. (2011). The physiological roles of dietary fibre. *Food hydrocolloids*, *25*(2), 238-250.
66. Eswaran, S., Muir, J., & Chey, W. D. (2013). Fiber and functional gastrointestinal disorders. *Official journal of the American College of Gastroenterology| ACG*, *108*(5), 718-727.
67. Puupponen-Pimiä, R. A. M. A., Aura, A. M., Oksman-Caldentey, K. M., Myllärinen, P., Saarela, M., Mattila-Sandholm, T., & Poutanen, K. (2002). Development of functional ingredients for gut health. *Trends in Food Science & Technology*, *13*(1), 3-11.
68. Clifford, M. N. (2004). Diet-derived phenols in plasma and tissues and their implications for health. *Planta medica*, *70*(12), 1103-1114.
69. Bashir, N., Younis, K., & Yousuf, O. (2023). An Overview Encompassing the Present Status of Jaggery Processing. *Sugar Tech*, 1-13.
70. Vander Schoot, A., Helander, C., Whelan, K., & Dimidi, E. (2022). Probiotics and synbiotics in chronic constipation in adults: A systematic review and meta-analysis of randomized controlled trials. *Clinical Nutrition*.
71. Li, Y., Yu, Y., Wu, X., Liu, B., Ma, H., Zhao, X., ... & Zeng, Q. (2022). A specially designed yogurt supplemented with a combination of pro-and prebiotics relieve constipation in mice and humans. *Nutrition*, *103*, 111802.
72. Khan, A., Jamil, M., Ullah, M., Ullah, I., Zubair, M., & Saheem, S. (2023). Causes, Precautions and Management of Risk Factors Associated with Dehydration among Athletes: Risk Factors Associated with Dehydration among Athletes. *THE THERAPIST (Journal of Therapies & Rehabilitation Sciences)*.
73. Emmanuel, A., Mattace‐Raso, F., Neri, M. C., Petersen, K. U., Rey, E., & Rogers, J. (2017). Constipation in older people: a consensus statement. *International journal of clinical practice*, *71*(1), e12920.
74. Boilesen, S. N., Dias, F. C., Tahan, S., Melli, L. C., & de Morais, M. B. (2021). Fluid intake and urinary osmolality in pediatric patients with functional constipation. *European Journal of Nutrition*, *60*, 4647-4655.
75. Wilson, P. B. (2020). Associations between physical activity and constipation in adult Americans: Results from the National Health and Nutrition Examination Survey. *Neurogastroenterology & Motility*, *32*(5), e13789.
76. Vargas-García, E. J., & Vargas-Salado, E. (2013). Food intake, nutritional status and physical activity between elderly with and without chronic constipation. A comparative study. *Cirugia y cirujanos*, *81*(3), 214-220.
77. Tantawy, S. A., Kamel, D. M., Abdelbasset, W. K., & Elgohary, H. M. (2017). Effects of a proposed physical activity and diet control to manage constipation in middle-aged obese women. *Diabetes, metabolic syndrome and obesity: targets and therapy*, 513-519.
78. Ojo, O. (2017). Optimising nutrition for older people with constipation. *Nursing and Residential Care*, *19*(8), 440-444.
79. Gelinas, P. (2013). Preventing constipation: a review of the laxative potential of food ingredients. *International journal of food science & technology*, *48*(3), 445-467.
80. Lembo, A. (2023). Chronic constipation. *Handbook of Gastrointestinal Motility and Disorders of Gut-Brain Interactions*, 263-276.
81. Bharucha, A. E., Wouters, M. M., & Tack, J. (2017). Existing and emerging therapies for managing constipation and diarrhea. *Current opinion in pharmacology*, *37*, 158-166.
82. Chuchawankul, S., Rajasekharan, S., Wongsirojkul, N., & Nilkhet, S. (2023). Cloud Ear Fungus (Auricularia polytricha). *Mushrooms: Nutraceuticals and Functional Foods*, 6.
83. Quagliani, D., & Felt-Gunderson, P. (2017). Closing America’s fiber intake gap: communication strategies from a food and fiber summit. *American journal of lifestyle medicine*, *11*(1), 80-85.
84. Borah, T. R., Singh, A. R., Paul, P., Talang, H., Kumar, B., & Hazarika, S. (2019). Spawn production and mushroom cultivation technology. *ICAR research complex for NEH region*, *46*.
85. Williams, B. A., Mikkelsen, D., Flanagan, B. M., & Gidley, M. J. (2019). “Dietary fibre”: moving beyond the “soluble/insoluble” classification for monogastric nutrition, with an emphasis on humans and pigs. *Journal of Animal Science and Biotechnology*, *10*(1), 1-12.
86. Williams, B. A., Mikkelsen, D., Flanagan, B. M., & Gidley, M. J. (2019). “Dietary fibre”: moving beyond the “soluble/insoluble” classification for monogastric nutrition, with an emphasis on humans and pigs. *Journal of Animal Science and Biotechnology*, *10*(1), 1-12.