



MORE THAN JUST STAYING REGULAR

An Experts' Consensus On the Role of
Psyllium Fibre Dietary Supplement in Early
Intervention of Chronic Diseases



Executive Summary

The rising prevalence of inadequate dietary fibre intake is a growing concern for public health. Dietary fibre plays a crucial role in maintaining digestive health and overall well-being, with adequate intake associated with myriad health benefits, notably reduced risk of developing chronic diseases. However, many individuals fall short of meeting the recommended daily intake of dietary fibre.

The use of fibre supplementation can address this gap in fibre intake. However, not all fibres are equal in their capacity to deliver beneficial physiological effects. A body of evidence suggests that supplementation of psyllium fibre, likely due to its unique physicochemical properties, confers benefits to not only on digestive health, but also in cardiovascular health and blood sugar management.

In individuals with inadequate fibre intake, supplementation with psyllium fibre may offer specific utility in improving digestive health and reducing their risk of developing chronic diseases. This experts' consensus aims to discuss the role of psyllium fibre dietary supplement in early intervention of chronic diseases.

Authors



Dr Daniel So

PhD at Monash University and Clinical Research Associate at Atmo Biosciences



Prof Elaine Chow

Assistant Professor, Phase 1 Clinical Trial Centre and Department of Medicine & Therapeutics, Faculty of Medicine, The Chinese University of Hong Kong



Dr Jason Kaplan

Lead Cardiologist, GenesisCare Cardiology NSW and St Vincents Private Hospital



Dr Said Khader

Consultant in Internal Medicine and Endocrinology, Dr Sulaiman Al Habib Medical Complex

What is dietary fibre and why is it important?

Dietary fibre is an important component of a healthy human diet and plays a multifaceted role in maintaining overall well-being of an individual. Diets rich in fibre are associated with overall health, reduced risk of mortality and reduced risk of developing a wide range of chronic diseases¹.

Fibres, defined by the Codex Alimentarius² as “carbohydrate polymers of at least three monomers which are not hydrolysed by the endogenous enzymes in the small intestine”, are found in plant-based foods where they naturally occur and as supplements, isolated and extracted or synthesised³.

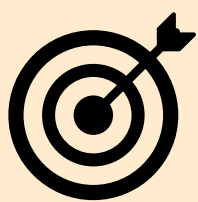
A high fibre diet is associated with numerous health benefits including (but not limited to):

- 🌿 Improvement to gut health and bowel regularity^{4,5}
- 🌿 Lowering serum cholesterol
- 🌿 Improvement in glycaemic control⁶
- 🌿 Reduction in risk for heart disease and diabetes⁶



Recommended dietary fibre intake across populations

A review article³ which assessed actual fibre intakes in Europe, UK, and USA, reported that the average fibre intake for adult males ranged from 15 to 25g/day, while for adult females the average was 14 to 21g/day. This is about 10g lower than the recommended intake of 25-35g/day for adults in most countries^{3,7} as summarized below.



Recommended Daily Adequate (RDA) intake^{3,7,8}

♀ 25g/d ♂ 35g/d



Actual daily average intake of fibre globally is significantly lower than the RDA

Actual Daily Average Intake (global)³

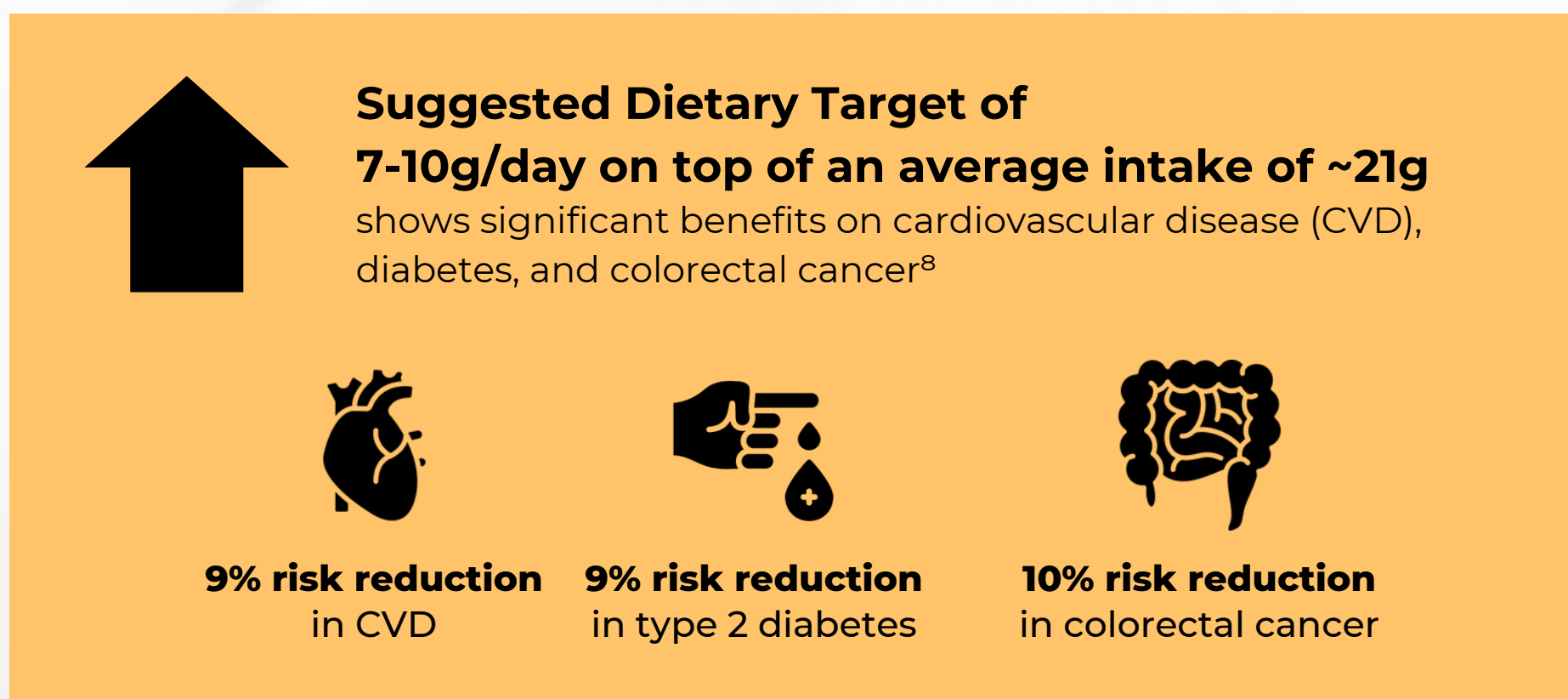
♀ 14-21g/d ♂ 15-25g/d

Average daily fibre intake across countries




Asia and Australia Average Daily Fibre Intake ^{8,9}	9.3-24.0g (Female)/ day 10.1-23.6g (Male)/ day
Saudi Arabia Average Daily Fibre Intake ¹⁰	14.2g (Female)/day 12.4g (Male)/ day

The lower than recommended fibre intake among individuals highlights the need for additional fibre intakes among populations.

In fact, while the recommended dose is ~25-35g of fibre (Adequate Intake), meta-analysis showed that additional dietary fibre intake of 7-10g per day on top of the average diet (Suggested Dietary Target; SDT: 28-38g fibre) is associated with risk reduction in cardiovascular disease by 9%, type 2 diabetes by 9% and colorectal cancer by 10%⁸.



↑ Suggested Dietary Target of 7-10g/day on top of an average intake of ~21g shows significant benefits on cardiovascular disease (CVD), diabetes, and colorectal cancer⁸

-  **9% risk reduction** in CVD
-  **9% risk reduction** in type 2 diabetes
-  **10% risk reduction** in colorectal cancer



High risk groups for low fibre intake



Children and teenagers who consume diets high in processed foods, and low in fibre-rich foods may not meet their daily fibre requirements.

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Majority of adolescent and children consume low dietary fibre. Older adults are more likely to have higher fibre diets in general. - *Dr Said Khader*

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Obese individuals may gravitate towards highly processed, calorie-dense foods that are often low in fibre. Low-fibre foods contribute less satiety as compared to those rich in fibre, leading to increased calorie consumption and weight gain.

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Our own data showed that obese individuals generally have lower fibre intake - *Dr Elaine Chow*

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Limited access to fresh fruits, vegetables, and whole grains due to economic constraints may lead to low fibre intake.

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Social economic status would also play a large part in fibre intake as lower income individuals would likely gravitate towards cheaper fast foods as compared to healthy meals, which often have lower fibre intake - *Dr Jason Kaplan*

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Some restrictive diets, such as very low-carbohydrate diets, may inadvertently lead to low fibre intake if not carefully planned to include fibre-rich foods.

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Patients prioritize reducing carbohydrates and sugars but find it difficult to grasp the concept of increase fibre intake. Many patients also go on restrictive diets (e.g. Keto diets) which decreases the total carbohydrate intake, however, daily fibre intake reduces simultaneously. - *Dr. Elaine Chow*

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Not all dietary fibres are the same, with specific types of fibre conferring different physiological effects

It is important to recognize that not all fibres are created equal and fibres vary in their composition and effects on the body. Fibres can be categorized by a few factors – bulking, fermentability and viscosity.

The table below highlights the different spectrum of fibre types and characteristics.

Fibre type		Examples of fibre	Characteristics
With no water-holding capacity	Insoluble, minimally fermented	<ul style="list-style-type: none"> • Wheat bran 	<ul style="list-style-type: none"> • Does not dissolve in water • Poorly fermented
	Soluble, non-viscous, readily fermented	<ul style="list-style-type: none"> • Inulin • Wheat dextrin • Oligosaccharides • Resistant starches 	<ul style="list-style-type: none"> • Dissolves in water with no increase in viscosity • Rapidly and completely fermented
With water-holding capacity	Soluble viscous, readily fermented	<ul style="list-style-type: none"> • Beta-glucan [oats, barley] • Raw guar gum 	<ul style="list-style-type: none"> • Dissolves in water, forms a viscous gel • Increases chyme viscosity • Readily fermented
	Soluble, viscous, non-fermented	<ul style="list-style-type: none"> • Psyllium husk 	<ul style="list-style-type: none"> • Dissolves in water to form a viscous gel • Increases chyme viscosity • Bulking effect • Not fermented

“

We should be looking at the full spectrum of effects that fibres offer in terms of bulking, viscosity and fermentability, beyond solubility, and need to communicate that to the consumer and healthcare professionals (HCPs)

- Dr Daniel So

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Role of fibre supplementation and its benefits

Fibre supplementation has become progressively common in modern diets as a convenient modality of increasing fibre consumption.

Some common fibre sources as well as their associated characteristics and evidence of health benefits are summarized below.

Types of fibres	Psyllium	Inulin	Wheat Dextrin	Methylcellulose
Physical properties				
Natural	Yes	Yes	Yes	Semi-synthetic
Soluble	70-80%	100%	100%	100%
Mode of action				
Holds water	Yes	No	No	Yes
Forms gel	Yes	No	No	No
Bulks stool	Yes	No	No	Partially
Health benefits				
Traps bile acid	Yes	No data	No	Possibly
Lowers blood cholesterol	Yes	No	No	Minimal
Helps lower risk of heart disease	Yes	No data	Inadequate data	No data
Modulates postprandial blood glucose levels	Yes	No data	Inadequate data	No data

Among the various fibre supplements highlighted, psyllium fibre stands out as a notable option. Clinical research has demonstrated that psyllium fibre, with its soluble, non-fermenting, gel-forming properties, provides a wide spectrum of health benefits which are typically associated with fibre supplementation¹¹.

Psyllium fibre is derived from the seed husk of the *Plantago ovata* plant and is distinguished by its unique blend of both soluble and insoluble fibres.

Psyllium is unique among dietary fibres for the following combined attributes:

- ✔ High water-holding capacity
- ✔ Relative resistance to fermentation by colonic bacteria¹²
- ✔ Ability to normalize stool consistency¹³
- ✔ Ability to form a viscous gel which traps cholesterol and glucose in the diet, leading to reduced serum cholesterol and attenuation of postprandial hyperglycaemia¹⁴
- ✔ Other benefits include weight control due to higher satiety effects¹⁵ and alleviation of irritable bowel syndrome symptoms¹⁶

There are no known significant drug interactions with chronic medications (e.g. for diabetes, cholesterol), although some literature caution potential interaction with oral medication and advise separate administration timing by 2 hours^{17,18}.

Benefits of Psyllium Fibre



Hyperlipidemia management and risk reduction

- ✔ Reduction in bile acid
- ✔ Lowers blood LDL-cholesterol levels

Management and risk reduction of diabetes mellitus and its complications

- ✔ Increases chyme viscosity
- ✔ Delay in absorption and degradation of glucose

Reduction in obesity risk or weight management

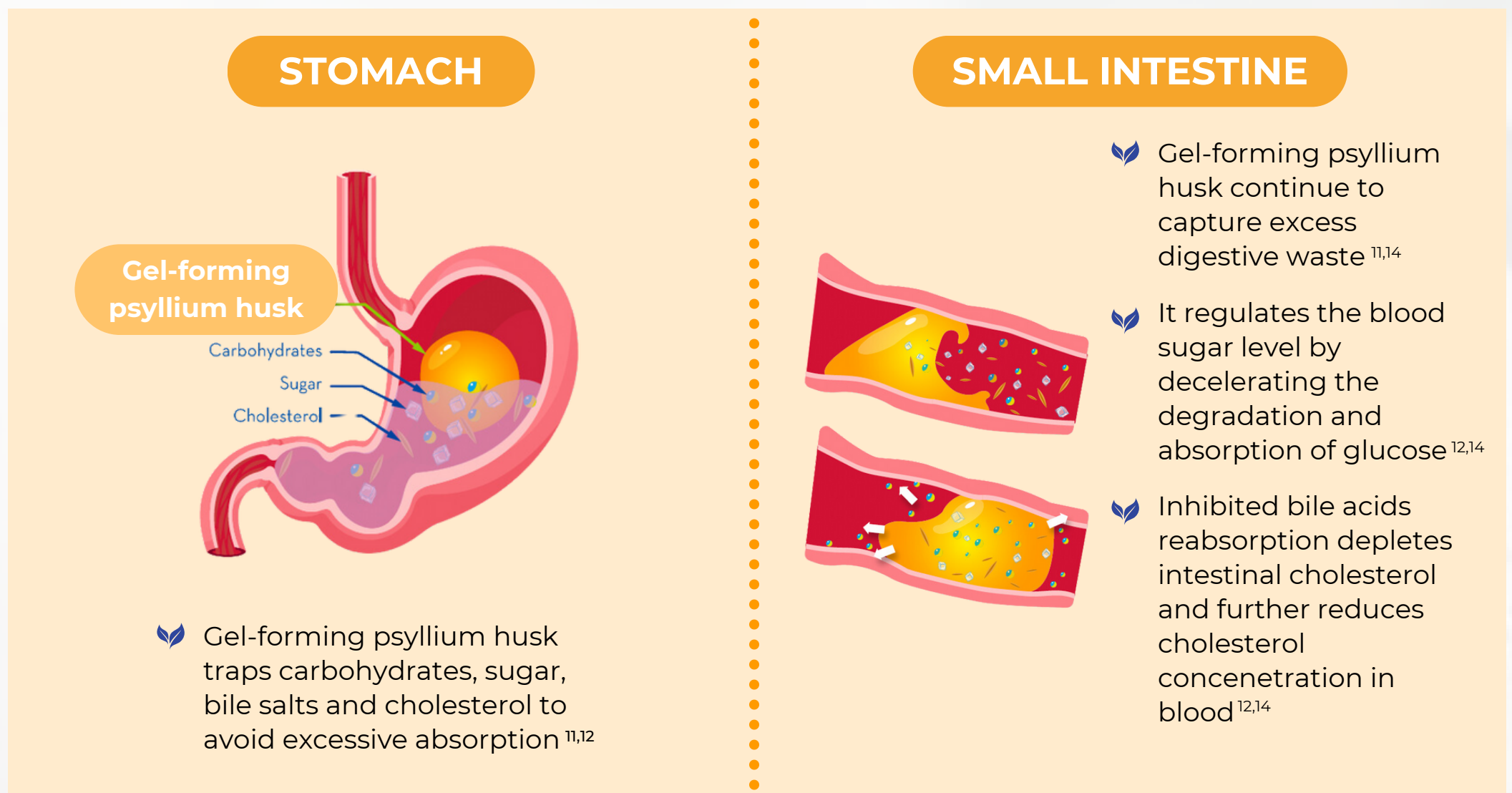
- ✔ Increases satiety, delays hunger and decreases energy intake
- ✔ Increases chewing time

Mechanism of action of Psyllium Fibre

Psyllium bulks and firms up loose stool through its high soluble fibre content and ability to absorb water, which helps to regulate bowel movements and alleviate symptoms of constipation and diarrhea.

Beyond its effects on bowel habits, psyllium fibre also has beneficial effects on blood sugar and cholesterol levels through its gel-forming effect.

Psyllium gel mechanism of action in the stomach and small intestine is summarized below.



As described in the illustration above, psyllium fibre forms a gel-like substance when mixed with water in the gastrointestinal tract, which increases chyme viscosity. This in turn slows movement of chyme through the digestive tract, allowing for slower but better nutrient absorption and feelings of satiety. Additionally, it decreases degradation and absorption of glucose and cholesterol from the intestines, thereby stabilizing blood sugar and cholesterol levels.

The gel-forming property of psyllium also supports binding of bile acids in the digestive tract, promoting bile excretion from the body and further reducing blood cholesterol levels.

Psyllium fibre's effectiveness in promoting digestive health and overall well-being has strengthened its position as a prominent choice for individuals seeking to enhance their fibre intake through dietary supplement.



Role of Psyllium Fibre on constipation

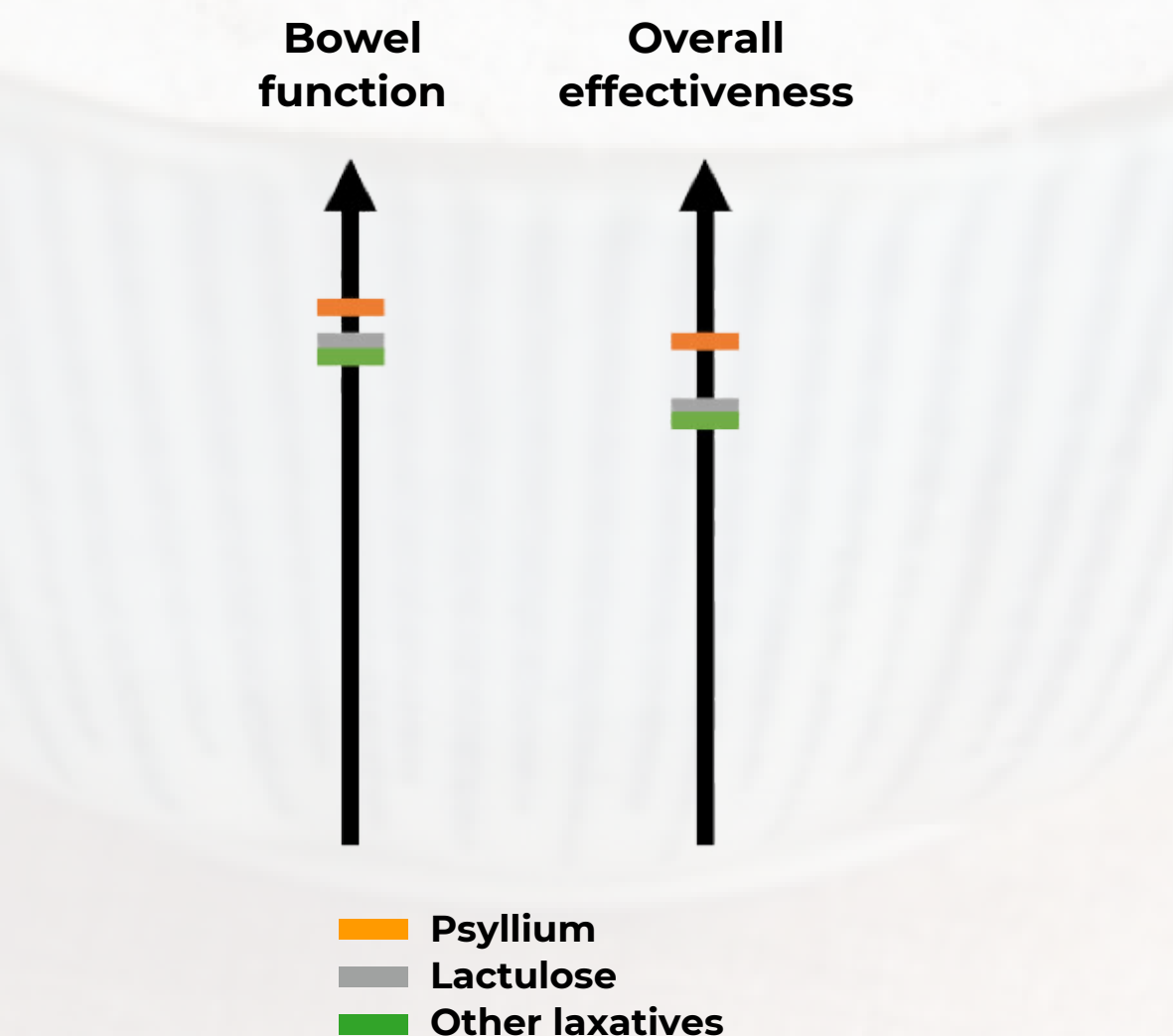
Constipation is a common gastrointestinal issue characterised by infrequent bowel movements and difficulty in passing stools. This condition affects approximately 11.7% of the global population¹⁹.

There are a variety of treatment options available for constipation, including different types of laxatives such as stimulant laxatives, lubricating agents, and bulk-forming agents. As a bulk-forming agent, psyllium fibre in particular has shown superior effectiveness compared to other fibre supplements and laxatives²⁰.

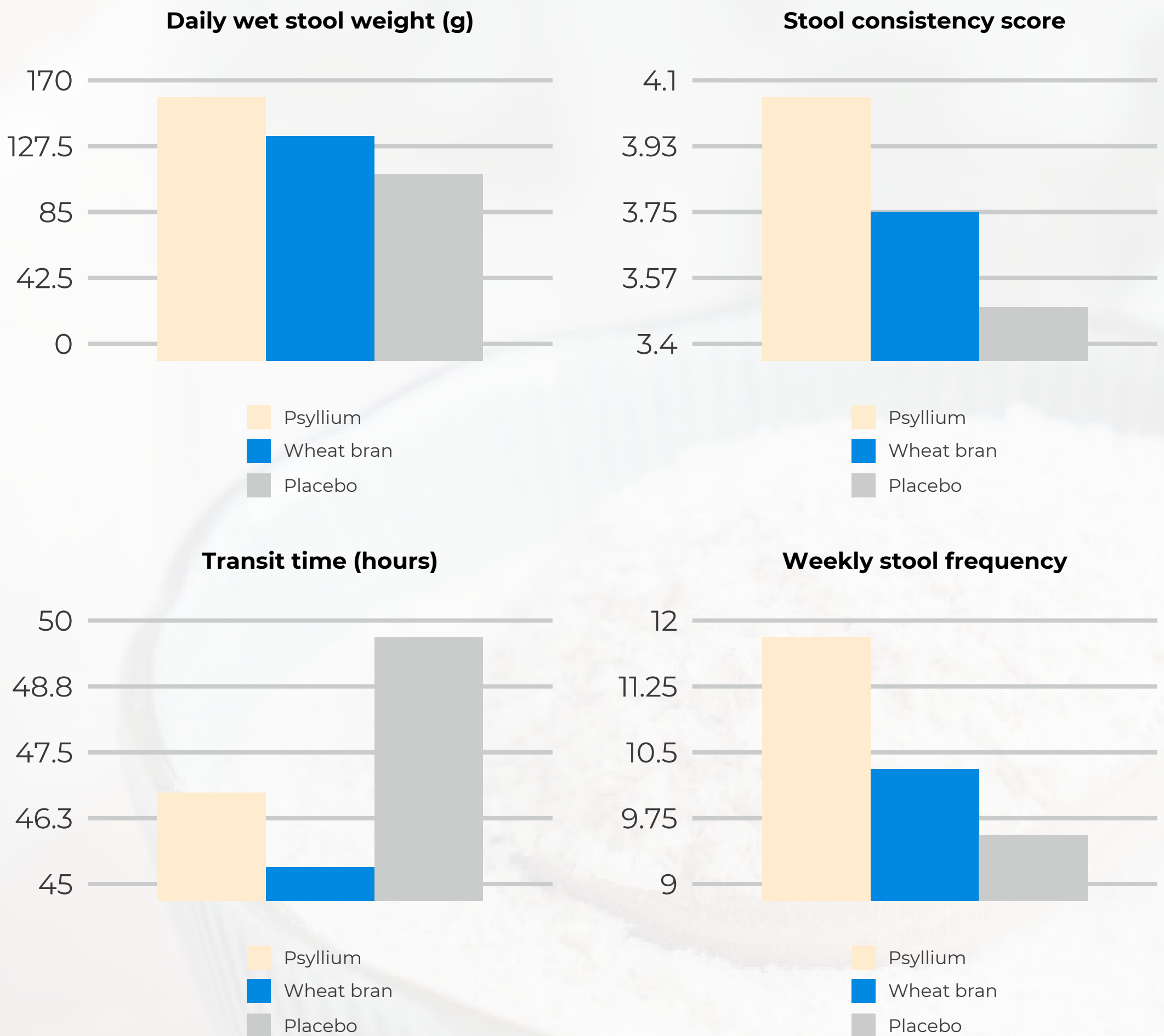
Types of laxatives for the treatment of constipation

Types of laxative	Mechanism	Example
Bulk-forming	Absorbs liquid in intestine to create bulky, liquid like stool	Psyllium (Ispaghula), methylcellulose
Lubricating	Coat stools with oily substance, allowing moisture retention for softer stool	Liquid paraffin, mineral oil
Stimulant	Stimulate bowel movement through contraction of intestinal muscles	Bisacodyl, sennosides
Osmotic	Draws water into stool, creating softer stool	Polyethylene glycol (PEG), lactulose

Psyllium fibre stands out amongst other types of fibre and laxatives due to its efficacy and minimal side effects²⁰.



The figures below compares effects of psyllium compared to other fibre supplementation²¹



While the benefits of fibre in managing constipation are widely recognized, it is crucial to personalize the approach based on a patient's dietary intake and bowel habits to ensure tolerability and effectiveness.

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It is important to create awareness among HCPs on the differences between supplements and their effects in the gut. An individual who is struggling with poor bowel function would likely benefit more from psyllium supplementation, as compared to inulin. – *Dr Daniel So*

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Role of Psyllium Fibre on Cholesterol Control

Hyperlipidemia is a condition marked by high levels of total and low-density lipoprotein cholesterol (LDLc) in the blood, which are known risk factors for cardiovascular diseases (CVD).

Cardiovascular diseases have a significant global impact. As per the World Health Organization's 2021 data²², an estimated 17.9 million people died from cardiovascular diseases in 2019 alone. This constituted a substantial 32% of all global deaths that year, underlining the critical need for effective management and treatment strategies for conditions like hyperlipidemia.

In younger individuals, elevated levels of LDLc present the strongest risk for developing CVD. The CARDIA study, focusing on this younger population, reveals that a reduction in cholesterol levels by 1.0mmol can decrease future CVD risk by a significant 25%.

Introducing psyllium fibre dietary supplement has the potential to achieve this reduction, offering effects comparable to a low-dose statin, a common cholesterol management medication.

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The causal role of low density lipoprotein (LDL-C) in atherosclerosis is firmly established and the concept of “cholesterol years” represents the cumulative exposure of the arteries to elevated LDL-C and is a product of both the magnitude and duration of this exposure. The greater this exposure, the higher the chance of developing atherosclerosis. – *Dr Jason Kaplan*

”

Psyllium fibre could improve success of lifestyle management in hypercholesterolemia patients

Supplementation with dietary fibre is increasingly recommended in numerous guidelines²³ as a preventative measure against CVD, highlighting the growing emphasis on lifestyle modifications.

In a recent cross-sectional study by Zhang et al., 2022²³, findings highlighted that a diet rich in fibre may decrease the risk of atherosclerosis cardiovascular disease (ASCVD) in subjects with intermediate to high risk.

While most guidelines do not specify the recommended dosage of fibre dietary supplement, daily supplementation of around 7-10g psyllium fibre on top of an average diet has demonstrated to effectively reduce LDLc in hypercholesterolemia patients.

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The cornerstone of managing younger and lower risk patients for the primary and primordial prevention of atherosclerotic cardiovascular disease should emphasize lifestyle modification strategies. - *Dr Jason Kaplan*

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Plant based and Mediterranean diets, along with increased fruit, nut, vegetable, legum, and lean vegetable or animal protein (preferably fish) consumption, with the inherent soluble and insoluble vegetable fibre, have consistently been associated with lower risk of all-cause mortality than control or standard diets in observational studies.

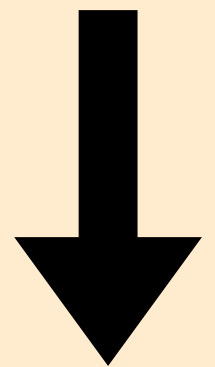
- Recommendation from 2019 ACC/AHA guideline²⁴ for primary prevention of cardiovascular disease do not provide specific guideline on fibre intake.

Psyllium fibre supplements is recommended as a co-treatment with **statin in hypercholesterolemia patients with low to moderate CVD risk in hypercholesterolemia patients.**

Clinical evidence supports the efficacy of psyllium fibre for controlling cholesterol.

In fact, studies show that supplementing diets with psyllium fibre improves the efficacy of statin therapy and may be recommended for statin intolerant patients or those requiring higher dosages of statin therapy²⁵. Hence, psyllium fibre allows patients to achieve their target cholesterol goals with a lower statin dosage and minimal additional side effects.

Adding psyllium fibre to statin therapy can further decrease LDL-c levels, an effect equivalent to doubling the dosage of statins²⁵



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Psyllium fibre supplementation effectively reduces cholesterol absorption and up-regulates LDL receptors, which works differently from statins as HMG-CoA reductase inhibitors. The complementary effect will improve the LDL-c reduction to a greater extent than taking statins alone. In people already taking high doses of statins, the addition of a therapeutic dose of psyllium may lead to a greater reduction in cholesterol than higher doses of medications with no side effect profile and other beneficial effects. - *Dr Jason Kaplan*

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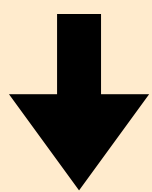
Role of Psyllium Fibre on Glucose Control

Type 2 diabetes mellitus, a chronic condition characterized by either insufficient insulin production from the pancreas or ineffective insulin utilization by the body, affects approximately 10.5% of adults globally²⁶.

Alongside existing treatment options aimed at curbing and controlling blood glucose levels in diabetic patients, there is a growing recognition of the pivotal role lifestyle management plays in delaying and managing diabetes.

Psyllium fibre has been studied extensively for its potential benefits in glucose control among diabetic patients. Research has demonstrated that psyllium fibre can lead to reductions in various indices used to measure blood glucose levels, including HbA1c, fasting glucose, and postprandial glucose levels²⁷.

Among type 2 diabetes patients, psyllium fibre has been shown to improve glycemic control by reducing the following:



HbA1c: -0.97%

Fasting glucose: -37mg/dl

Postprandial glucose: -29mg/dl

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There are existing diabetes prevention programs to delay diabetes, but if we have intervention for the (pre-diabetes) group, it will be a great win for diabetologists – *Dr Said Khader*

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What is prediabetes?



Prediabetes occurs when blood sugar levels are higher than the norm, but not enough to be diagnosed as type 2 diabetes. Patients with prediabetes are also at increased risk of type 2 diabetes, heart disease and stroke.

Fortunately, with good control of lifestyle and blood sugar levels, individuals with prediabetes can prevent or delay progression into type 2 diabetes and other cardiovascular complications

The growing attention to pre-diabetes, or impaired glucose tolerance, highlights the increasing significance of preventive measures to mitigate the progression of diabetes.

Currently, there are no standardized, recommended interventions for patients at risk of developing diabetes, and existing pharmacological options are typically prescribed for the diabetic patient population rather than the pre-diabetic group. Psyllium fibre supplementation offers potential benefits with minimal adverse effects in reducing glycemic indices among pre-diabetic individuals, holding a promise to address this unmet need within the pre-diabetic population.

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There is an unmet need in diet and supplement-based interventions for patients with impaired glucose tolerance and psyllium husk supplementation offers promise in this area. – *Dr Jason Kaplan*

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Current Challenges in Accessing Dietary Fibre Supplementation

- ✦ There is a lack of awareness and education efforts on different fibre properties and their related health benefits.
- ✦ Patients are not aware on the importance of sufficient dietary intake, and fibre intake may be significantly reduced among individuals under strict diet regimens
- ✦ There is a tendency to prescribe pharmacological interventions as a quick fix, rather than taking a more holistic approach through combination of pharmacotherapy with lifestyle management.

Thus, it is important to create awareness among healthcare providers on the different fibre supplements available and their effects on the patients.

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Wrong recommendations may lead patients to avoid all types of fibre supplementation in the future, so it is important to make know that not all fibres are interchangeable. - *Dr Daniel So*

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Convenience to change dietary habit should be made easy for patients; versatility of product will help incorporate fibre into the typical food intake. - *Dr Elaine Chow*

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Recommended Amount of Psyllium Fibre Dietary Supplement

Based on currently available evidence, the amount of psyllium fibre dietary supplement may be introduced to improve gut health and associated with the following health benefits:

Health Benefits	Recommended Psyllium Amount (per day)	Clinical Effects
Maintenance of regularity against constipation, diarrhea and Irritable Bowel Syndrome	3g to 10g	In patients with constipation: +31% stool evacuation frequency ²⁸ +64% stool weight ²⁸ -23% deposition pain ²⁸
Blood glucose maintenance	7g to 20g	In Type 2 diabetic patients: -37.0mg/dL fasting blood glucose ²⁷ -29mg/dL postprandial glucose ²⁷ -0.97% HbA1c ²⁷
Blood cholesterol reduction	3g to 20.4g	In hypercholesterolemia patients: -32.8mg/dL total cholesterol ²⁹ -12.6mg/dL LDLc ³⁰ -18mg/dL triglyceride ³¹



Conclusion

In conclusion, emerging evidence suggests that increasing dietary fibre intake daily could serve as a novel approach for early intervention against chronic diseases like CVD and diabetes.

It is crucial to recognize that not all fibres are the same, each possessing distinct functional properties and benefits. Among these, psyllium husk stands out as a viscous, soluble, and non-fermented fibre. Beyond its role in promoting regularity, clinical studies have consistently demonstrated its efficacy in lowering blood cholesterol and glucose levels.

Therefore, incorporating psyllium fibre supplementation into the diet presents a promising strategy for mitigating the risk of cardiovascular and metabolic diseases, highlighting the importance of tailored dietary interventions in preventive healthcare strategies.

While psyllium fibre can offer potential benefits, it is essential to consider other aspects of a healthy lifestyle, including regular physical activity, a balanced diet, and overall well-being, for comprehensive disease prevention and management.



This paper is intended for Healthcare Professional educational purposes only. The information provided reflects only the perspectives and opinions of the authors following an expert round-table discussion. The development of this paper was supported by P&G Health and Ipsos.

References

1. Reynolds A, Mann J, Cummings J, Winter N, Mete E, Te Morenga L. Carbohydrate quality and human health: a series of systematic reviews and meta-analyses. *Lancet*. 2019 Feb 2;393(10170):434-445. doi: 10.1016/S0140-6736(18)31809-9. Epub 2019 Jan 10. Erratum in: *Lancet*. 2019 Feb 2;393(10170):406. PMID: 30638909.
2. Codex Alimentarius Commission. List of Methods for Dietary Fibre at Step 7: Comments at step 6 of the Procedure. Food and Agriculture Organisation of the United Nations. 2009. Retrieved on 3 Mar 2024. Available from: https://www.fao.org/fao-who-codexalimentarius/sh-proxy/zh/?Ink=1&url=https%253A%252F%252Fworkspace.fao.org%252Fsites%252Fcodex%252Fshared%2BDocuments%252FArchive%252FMeetings%252FCCNFSDU%252Fccnfsdu31%252Ffnf31_03ae.pdf
3. Stephen, A. M., Champ, M. M., Cloran, S. J., Fleith, M., van Lieshout, L., Mejbourn, H., & Burley, V. J. Dietary fibre in Europe: current state of knowledge on definitions, sources, recommendations, intakes and relationships to health. *Nutrition research reviews*. 2017. 30(2), 149-190. <https://doi.org/10.1017/S095442241700004X>
4. So D, Gibson PR, Muir JG, Yao CK. Dietary fibres and IBS: translating functional characteristics to clinical value in the era of personalised medicine. *Gut*. 2021 Dec;70(12):2383-2394. doi: 10.1136/gutjnl-2021-324891. Epub 2021 Aug 20. PMID: 34417199.
5. Radziszewska, M., Smarkusz-Zarzecka, J., & Ostrowska, L. Nutrition, Physical Activity and Supplementation in Irritable Bowel Syndrome. *Nutrients*. 2023. 15(16), 3662. <https://doi.org/10.3390/nu15163662>
6. Chu NHS, He J, Leung KHT, Ma RCW, Lee JYS, Varney J, Chan JCN, Muir JG, Chow E. Higher Short-Chain Fermentable Carbohydrates Are Associated with Lower Body Fat and Higher Insulin Sensitivity in People with Prediabetes. *Nutrients*. 2023 Dec 11;15(24):5070. doi: 10.3390/nu15245070. PMID: 38140329; PMCID: PMC10745595.
7. Centre for Health Protection (CHP) Ageing. Dietary Fibre. 2023 Aug 25. Retrieved on 3 Mar 2024. Available from: <https://www.chp.gov.hk/en/static/90018.html#:~:text=The%20recommended%20daily%20dietary%20fibre,to%20their%20age%20plus%20five>.
8. Fayet-Moore F, Cassettari T, Tuck K, McConnell A, Petocz P. Dietary Fibre Intake in Australia. Paper I: Associations with Demographic, Socio-Economic, and Anthropometric Factors. *Nutrients*. 2018 May 11;10(5):599. doi: 10.3390/nu10050599. PMID: 29751656; PMCID: PMC5986479.
9. Yu, D., Zhao, L., & Zhao, W. Status and trends in consumption of grains and dietary fiber among Chinese adults (1982-2015). *Nutrition reviews*. 2020. 78(Suppl 1), 43-53. <https://doi.org/10.1093/nutrit/nuz075>
10. Alharbi MH, Alarifi SN. Gender-Based Differences in the Consumption of Food Rich in Fibre and Its Relationship with Perceived Mood Status: A Cross-Sectional Study. *Healthcare (Basel)*. 2022 Apr 14;10(4):730. doi: 10.3390/healthcare10040730. PMID: 35455907; PMCID: PMC9030175.
11. McRorie JW Jr. Evidence-Based Approach to Fiber Supplements and Clinically Meaningful Health Benefits, Part I: What to Look for and How to Recommend an Effective Fiber Therapy. *Nutr Today*. 2015 Mar;50(2):82-89. doi: 10.1097/NT.0000000000000082. PMID: 25972618; PMCID: PMC4415962.
12. Marteau P, Flourié B, Cherbut C, Corrèze JL, Pellier P, Seylaz J, Rambaud JC. Digestibility and bulking effect of ispaghula husks in healthy humans. *Gut*. 1994 Dec;35(12):1747-52. doi: 10.1136/gut.35.12.1747. PMID: 7829013; PMCID: PMC1375264
13. McRorie JW, Daggy BP, Morel JG, Diersing PS, Miner PB, Robinson M. Psyllium is superior to docusate sodium for treatment of chronic constipation. *Aliment Pharmacol Ther*. 1998 May;12(5):491-7. doi: 10.1046/j.1365-2036.1998.00336.x. PMID: 9663731
14. Lairon D. Soluble fibers and dietary lipids. *Adv Exp Med Biol*. 1997;427:99-108. doi: 10.1007/978-1-4615-5967-2_12. PMID: 9361836.
15. Brum JM, Gibb RD, Peters JC, Mattes RD. Satiety effects of psyllium in healthy volunteers. *Appetite*. 2016 Oct 1;105:27-36. doi: 10.1016/j.appet.2016.04.041. Epub 2016 May 7. PMID: 27166077
16. Gibb, R. D., Sloan, K. J., & McRorie, J. W., Jr. Psyllium is a natural nonfermented gel-forming fiber that is effective for weight loss: A comprehensive review and meta-analysis. *Journal of the American Association of Nurse Practitioners*. 2023. 35(8), 468-476. <https://doi.org/10.1097/JXX.0000000000000882>
17. Wolters Kluwer. Psyllium: Drug interactions. Uptodate. 2024. Retrieved on 3 Mar 2024. Available from: https://www.uptodate.com/contents/psyllium-drug-information?search=psyllium&topicRef=2636&source=see_link#F215627.
18. Baljit S. Psyllium as therapeutic and drug delivery agent. *International Journal of Pharmaceutics*. 334 (2007). 1-14. doi:10.1016/j.ijpharm.2007.01.028.
19. Sperber, A. D., Bangdiwala, S. I., Drossman, D. A., Ghoshal, U. C., Simren, M., Tack, J., Whitehead, W. E., Dumitrascu, D. L., Fang, X., Fukudo, S., Kellow, J., Okeke, E., Quigley, E. M. M., Schmulson, M., Whorwell, P., Archampong, T., Adibi, P., Andresen, V., Benninga, M. A., Bonaz, B., Palsson, O. S. Worldwide Prevalence and Burden of Functional Gastrointestinal Disorders, Results of Rome Foundation Global Study. *Gastroenterology*. 2021. 160(1), 99-114.e3. <https://doi.org/10.1053/j.gastro.2020.04.014>
20. Dettmar, P. W., & Sykes, J. A multi-centre, general practice comparison of ispaghula husk with lactulose and other laxatives in the treatment of simple constipation. *Current medical research and opinion*. 1998. 14(4), 227-233. <https://doi.org/10.1185/03007999809113363>
21. Ornstein M H, Littlewood E R, Baird I M, Fowler J, North W R, Cox A G et al. Are fibre supplements really necessary in diverticular disease of the colon? A controlled clinical trial. *Br Med J (Clin Res Ed)* 1981; 282 :1353 doi:10.1136/bmj.282.6273.1353
22. World Health Organisation. Cardiovascular diseases. World Health Organisation. 2021. Accessed on 16 December 2023. Available from: [https://www.who.int/news-room/fact-sheets/detail/cardiovascular-diseases-\(cvds\)](https://www.who.int/news-room/fact-sheets/detail/cardiovascular-diseases-(cvds)).
23. Zhang, S., Tian, J., Lei, M., Zhong, C., & Zhang, Y. Association between dietary fiber intake and atherosclerotic cardiovascular disease risk in adults: a cross-sectional study of 14,947 population based on the National Health and Nutrition Examination Surveys. *BMC public health*. 2021. 22(1), 1076. <https://doi.org/10.1186/s12889-022-13419-y>
24. Arnett, D. K., Blumenthal, R. S., Albert, M. A., Buroker, A. B., Goldberger, Z. D., Hahn, E. J., Himmelfarb, C. D., Khera, A., Lloyd-Jones, D., McEvoy, J. W., Michos, E. D., Miedema, M. D., Muñoz, D., Smith, S. C., Jr, Virani, S. S., Williams, K. A., Sr, Yeboah, J., & Ziaeian, B. 2019 ACC/AHA Guideline on the Primary Prevention of Cardiovascular Disease: A Report of the American College of Cardiology/American Heart Association Task Force on Clinical Practice Guidelines. *Circulation*. 2019. 140(11), e596-e646. <https://doi.org/10.1161/CIR.0000000000000678>
25. Moreyra, A. E., Wilson, A. C., & Koraym, A. Effect of combining psyllium fiber with simvastatin in lowering cholesterol. *Archives of internal medicine*. 2005. 165(10), 1161-1166. <https://doi.org/10.1001/archinte.165.10.1161>
26. International Diabetes Federation. About diabetes: Facts & Figures. International Diabetes Federation. (2024). Accessed on 16 December 2023. Available on: <https://idf.org/about-diabetes/diabetes-facts-figures/>
27. Gibb, R. D., McRorie, J. W., Jr, Russell, D. A., Hasselblad, V., & D'Alessio, D. A. Psyllium fiber improves glycemic control proportional to loss of glycemic control: a meta-analysis of data in euglycemic subjects, patients at risk of type 2 diabetes mellitus, and patients being treated for type 2 diabetes mellitus. *The American journal of clinical nutrition*. 2015. 102(6), 1604-1614. <https://doi.org/10.3945/ajcn.115.106989>
28. Ashraf W, Park F, Lof J, Quigley EM. Effects of psyllium therapy on stool characteristics, colon transit and anorectal function in chronic idiopathic constipation. *Aliment Pharmacol Ther*. 1995 Dec;9(6):639-47. doi: 10.1111/j.1365-2036.1995.tb00433.x. PMID: 8824651
29. Anderson JW, Allgood LD, Lawrence A, Altringer LA, Jerdack GR, Hengehold DA, Morel JG. Cholesterol-lowering effects of psyllium intake adjunctive to diet therapy in men and women with hypercholesterolemia: meta-analysis of 8 controlled trials. *Am J Clin Nutr*. 2000 Feb;71(2):472-9. doi: 10.1093/ajcn/71.2.472. PMID: 10648260.
30. Jovanovski E, Yashpal S, Komishon A, Zurbau A, Blanco Mejia S, Ho HVT, Li D, Sievenpiper J, Duvnjak L, Vuksan V. Effect of psyllium (*Plantago ovata*) fiber on LDL cholesterol and alternative lipid targets, non-HDL cholesterol and apolipoprotein B: a systematic review and meta-analysis of randomized controlled trials. *Am J Clin Nutr*. 2018 Nov 1;108(5):922-932. doi: 10.1093/ajcn/nqy115. PMID: 30239559.
31. Nouredin S, Mohsen J, Payman A. Effects of psyllium vs. placebo on constipation, weight, glycemia, and lipids: A randomized trial in patients with type 2 diabetes and chronic constipation. *Complement Ther Med*. 2018 Oct;40:1-7. doi: 10.1016/j.ctim.2018.07.004. Epub 2018 Jul 10. PMID: 30219432.