

Fibre and Whole Grain

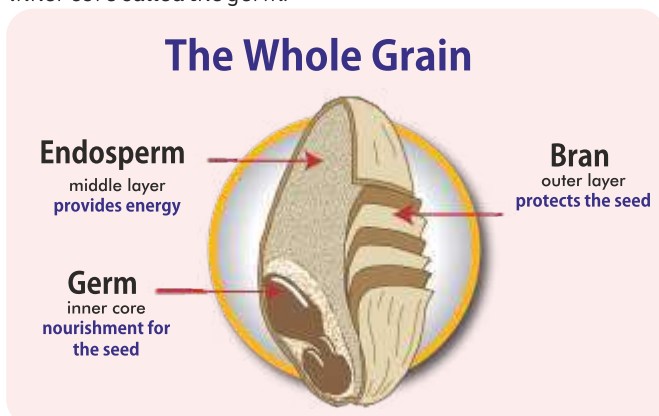


Grains are one of the major staple foods consumed across the globe and they constitute the largest component of the recommended dietary intake in all dietary guidelines. The grains food group includes grains as single foods (e.g. rice, oats) and products that include grains as an ingredient (e.g. bread, biscuits). Grains are either whole or refined.

Whole grains are being increasingly recognized worldwide as an integral part of a healthy eating pattern. They are an important source of nutrients such as dietary fibre, minerals and vitamins¹. Recent research provides evidences for the role of dietary whole grain consumption in reducing the risk for a whole gamut of health conditions such as cardiovascular diseases, type 2 diabetes and certain types of cancers². But as beneficial as they can be, it's vital to select whole grains that are also a good source of fibre. The reason being that evidence points to fibre as a key component in providing many of the health benefits linked to whole-grain foods. However, other bioactive compounds found in the bran and germ portions of whole grains may also contribute to the health protective mechanisms of whole grains³. The USDA's (US Department of Agriculture) 2015-2020 Dietary Guidelines for Americans thus states that at least half of the total recommended grain intake in a day's diet be contributed by whole grains¹.

■ How is whole grain defined?

The whole grain consists of the entire grain seed of the plant. This seed also called the kernel is made up of 3 parts, the outer layer or the bran, the middle layer or the endosperm and the inner core called the germ.



Source: Slavin J. *Proc Nutr Soc.* 2003 Feb;62(1):129-34.

Bran: is the natural tough outer protection for the seed beneath and provides dietary fibre, vitamins, minerals and phytochemicals that are responsible for the antioxidant potential of the grain.

Endosperm: is the biggest part of the grain and comprises of predominantly carbohydrates, protein and some B vitamins.

Germ: is the smallest fraction and the growing part of the seed. It contains a high lipid and protein content, minerals and vitamins such as vitamin A and vitamin E⁴.

Some examples of whole grains and whole grain products include whole wheat, whole-wheat flour, daliya (broken wheat), whole grain corn/cornmeal, whole oats/oatmeal, brown rice, whole barley; millets like whole jowar, bajra, ragi.

■ What are refined grains?

Refined grains have been processed so that some or all of the bran and/or germ have been removed. Removal of germ improves the shelf life of the product, while removal of the bran improves the hedonic experience of the consumer. However, refining eliminates bioactive components such as vitamins, minerals, antioxidants and critically fibre³. Some examples of refined grains are wheat flour, white bread and white rice.

Definition of whole grains by some "expert bodies"

The American Association of Cereal Chemists (AACC) International (this definition is also adopted by the US FDA): Whole grains consist of the intact, ground, cracked or flaked caryopsis (kernel) after removal of inedible parts such as hull and husk. The definition recognizes the fact that during milling the anatomical components may be fractionated but have to be recombined in the final product such that the endosperm, germ and bran are present in the same relative proportions as they exist in the intact kernel⁴.

The European HEALTHGRAIN Forum in addition to the above definition, allows for small losses of components (2% of whole grain/10% of bran) that occurs during essential processing methods, and this definition is applicable through the European Union⁵. This definition recognises that some parts of the grain, especially the outermost layers, are deliberately

removed during processing to cleanse potentially contaminated parts of the husk and outer bran.

Food Standards Australia New Zealand (FSANZ) : Whole grains are defined as “the intact grain or the dehulled, ground, milled, cracked or flaked grain where the constituents- endosperm, germ and bran- are present in such proportions that represent the typical ratio of those fractions occurring in the whole cereal, and includes wholemeal”⁶.

■ What is a whole grain food?

While whole grains may be consumed alone, they are most often ingredients within a food containing other ingredients. Although definitions exist for whole grains, a consistent definition for what constitutes a whole grain food has not been developed and adopted by any of the concerned bodies such as the FDA, the USDA or the European commissions⁷. A number of definitions including the one by US FDA however, agree that whole grain foods should contain over half their weight (more than 51%) from whole grain sources⁴. A more recent and practicable definition was proposed by an international cross-disciplinary group which suggested that the lowest amount a whole grain food product must contain was 8 g whole grain per 30 g serve in order to be labelled as a ‘whole-grain food’⁴.

Global ambiguity in clearly defining whole grain products may be a contributing factor to the widespread failure on the part of consumers to meet current whole grain recommendations. Hence, it is important to educate the consumers on dietary recommendations and food sources of whole grains.

■ Health benefits of fibre and whole grains

Reduces mortality risk

In both developed and developing countries, cardiovascular diseases (CVD) and cancer are major causes of mortality. A recent meta-analysis (meta-analysis provide the highest level of evidence) showed that a greater intake of both-total whole grains and specific whole-grain foods, was significantly associated with a lower risk of all-cause mortality, mortality from cardiovascular disease and risk of mortality from total cancers. An increase of 3 servings total whole grains/d was associated with a 17% lower risk of mortality from all causes, a 25% lower risk of mortality from CVD, and a 10% reduced risk of total-cancer mortality⁸.

A study among a large US population (3,67,442 participants) followed through a period of 14 years, found that increased consumption of whole grains or cereal fibre was significantly associated with reduced risk of all-cause mortality and death from CVD, cancer, diabetes, respiratory disease, infections, and other causes. As compared with individuals with the lowest intake of whole grains, those with the highest intake had a 17% lower risk of all-cause mortality and 11 to 48% lower risk of disease-specific mortality. The study specifically examined the association of the whole grain component, namely dietary fibre intake on mortality. As compared with individuals with the lowest intake of cereal fibre, those in the highest intake group had a 19% lower risk of all-cause

mortality and 15 to 34% lower risk of disease-specific mortality. The results suggested that the protective effects of whole grains may be due, at least in the main part, to its cereal fibre component⁹.

Wu H. et al (2015) in a study conducted with 2 large cohorts of US men and women suggested that higher whole grain consumption, with or without added bran or germ, can lower total and CVD mortality. In addition, the bran portion of the whole grain foods, as well as bran added to foods, was significantly associated with a lower CVD mortality. These findings were consistent with previous studies, Nurses’ Health Study (NHS) and Health Professionals Follow-Up study (HPFS) which also suggested that the bran component, but not germ, was significantly associated with reduced risk of diabetes, hypertension, Coronary Heart Disease (CHD) or CVD mortality among those with diabetes, after mutual adjustments of bran and germ.

The proposed mechanisms for these observed significant associations could be attributed to the nutrients and phytochemicals present in the bran portion of the whole grain¹⁰.

Bran is a rich source of fibre, B-group vitamins, vitamin E, magnesium, and phytochemicals.

Reduces CVD risk

It was seen that consumption of whole grain diets lowers LDL cholesterol and total cholesterol in apparently healthy adults when compared to non-whole grain control diets. The effect varied with the type of whole grain consumed and was augmented by simultaneous calorie restriction¹¹. Earlier studies have shown that the use of statins was associated with healthier lipoprotein profiles when combined with higher whole grain intake (>16 g) relative to lower whole grain intake¹².

A 6 week intervention trial on healthy adults who were low whole grain consumers (not more than 1 serving of whole grain or whole grain products/day) showed that the consumption of whole grain products resulted in a significant reduction in total, LDL and non-HDL cholesterol¹³. The lipid lowering effect in this study appeared to be due to the fibre content of the whole grain rather than due to beta glucan, an established cholesterol lowering agent found in oats.

In a study among overweight and obese adults it was seen that the improvement in diastolic blood pressure was >3 fold greater when they consumed a whole grain compared with a refined grain diet thus, lowering the risk for ischemic heart disease, stroke and other vascular diseases. It seems likely that diets enriched with whole grains may be linked to hypertension and CVD through an anti-inflammatory-related mechanism¹⁴.

American Society of Nutrition (ASN) position statement (2013) based on current scientific evidence concludes-

“Consumption of foods rich in cereal fibre or mixtures of whole grains and bran is modestly associated with a reduced risk of obesity, type 2 diabetes, and CVD”³².

Reduces risk for type 2 diabetes

A recent review of studies on the effect of whole grain consumption on metabolic parameters showed that the consumption of whole grain foods is able to improve acutely the postprandial glucose and insulin homeostasis compared to similar refined foods in healthy subjects¹⁵.

Chanson-Rolle et al report on an inverse relationship between whole grain consumption and the occurrence of type 2 diabetes up to an intake of whole grain ingredients of approximately 50 g/d. Their model of data analysis suggests an overall absolute reduction of 0.3% in risk of type 2 diabetes for each 10 g of whole grain consumed daily¹⁶.

Several plausible explanations have been put forth for the whole grain's mechanism of action in potentially reducing the incidence of type 2 diabetes.

1. The insoluble fibre of whole grains would delay gastric emptying and decrease the rate of glucose absorption²
2. Chromium and Magnesium in whole grains help maintain normal glucose and insulin metabolism²
3. Fermentation of fibre from whole grains in the large intestine produces short chain fatty acids (SCFAs) which improve glucose homeostasis and insulin sensitivity¹⁵
4. Prevention of oxidative damage to pancreatic cells that produce insulin because of the antioxidants in whole grains¹⁵

Reduces risk for cancer

The protective role of whole grains against cancer risk is biologically plausible through several mechanisms - lowering of adiposity, impact on sex hormone levels, protective effects of antioxidants and the health benefits of their dietary fibre content¹⁷. However, there is scientific evidence for the protective effect of whole grain consumption against only certain types of cancer such as head and neck¹⁷, renal cell carcinoma¹⁷, breast cancer¹⁸ and gastrointestinal cancers^{17,19}. Further studies using newer biomarkers are required in order to draw broader and more firm conclusions.

Reduces risk for obesity

Whole grains promote satiety because of their fibre content, promote insulin function that reduces lipogenesis and fat storage and whole grain consumption is often accompanied by a healthier life style². While epidemiological studies have consistently found an inverse association between whole grain intake and Body Mass Index (BMI), adiposity and weight gain, the collective evidence based on clinical trials have not been conclusive. A recent study found newer mechanistic insights that explain the epidemiological findings namely positive effects on Resting Metabolic Rate (RMR), increased energy excretion in stools and improved post prandial glucose response when whole grains were substituted for refined grains in the diets of men and post-menopausal women aged 40-65 years²⁰. Studies also found small but measureable improvements in body fat distribution (decreased visceral fat) with an energy restricted diet based on whole grains⁴.

Whole grains and gut health

The fibre from whole grains such as wheat is mostly insoluble and is known to increase stool bulk, reduce transit time, and make fecal elimination easier and quicker. In this way, consumption of insoluble fibre rich whole grains can regulate bowel functions to promote the wellbeing of healthy people and can function as a remedy to alleviate several gastrointestinal diseases such as peptic ulcers and cancer²¹.

Whole grains also contain several microbiota accessible substrates such as resistant starch and non-starch polysaccharides such as β -glucan and arabinoxylans, that resist digestion in the upper gastrointestinal tract, making them an important fuel for the gut microbiota. Microbial metabolites such as SCFAs, phenolic metabolites and secondary bile acids play a key role in the intersection between diet and metabolic health by regulating appetite, energy homeostasis, lipid and glucose metabolism, inflammatory status, oxidant stress and activation of the immune system²².

Wheat bran: the best fibre for promoting regularity

Wheat bran is a very rich source of insoluble fibre (arabinoxylans, cellulose and beta glucans) along with vitamins, minerals and antioxidants. It regulates gastrointestinal physiology and health by delaying gastric emptying and increasing fecal bulk. The effect of wheat bran on increasing fecal bulk is greater than other grains such as oats or vegetables and fruits²³. Wheat bran is considered as the "gold standard" when it comes to fecal bulking and promoting regularity since no other fibre or laxative has been shown to be as effective²⁴.

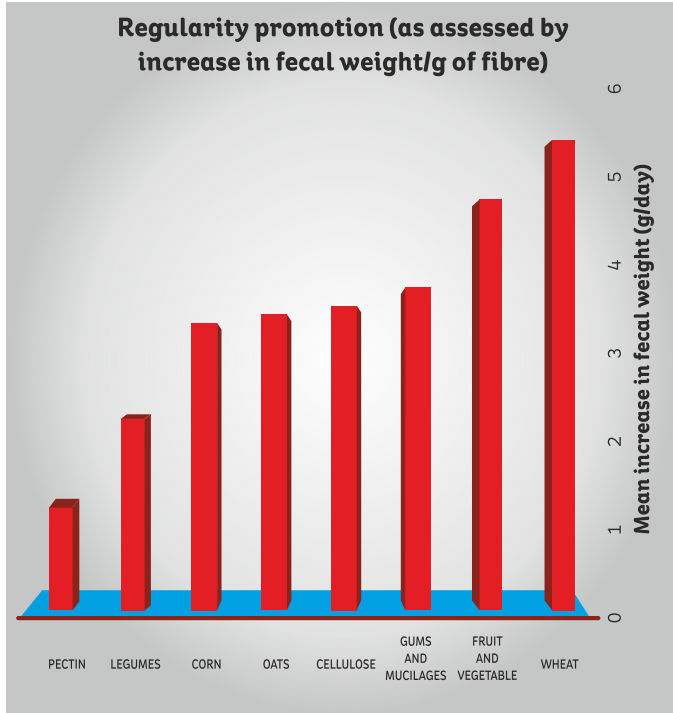
Consumption of wheat bran has protective effect against diseases such as cardiovascular, obesity, and gastrointestinal disorders such as constipation, diverticulosis and colorectal cancer²³.

European Food safety Authority (EFSA) has an approved health claim on wheat bran which states - "Wheat bran fibre contributes to an increase in faecal bulk and reduction in intestinal transit time"²⁵.



Regularity promotion (as assessed by increase in fecal weight/g of fibre)

Among 41 interventions that examined wheat fibre - which consisted largely of wheat bran - the mean increase in fecal weight per g/d of wheat fibre was 5.4 g. The mean increases in fecal weight per g/d of other sources of fibre were smaller in magnitude: fruit and vegetables (4.7 g), gums and mucilages (3.7 g), cellulose (3.5 g), oats (3.4 g), corn (3.3 g), legumes (2.2 g), and pectin (1.2 g)²⁶.



Lawson C, et al.²⁷, found significant improvements in digestive health, digestive comfort and general psychological wellbeing in habitual low-fibre consumers during the 2-week intervention period. The study participants were fed one bowl of ready-to-eat breakfast cereal containing at least 5.4 g fibre (of which 70% is wheat bran fibre) for 2 weeks duration. The physiological mechanism of action for the effect of wheat bran fibre on stool bulking and frequency is well-recognized, and relates to water absorption. The inability to digest cellulose and wheat bran fibre morphology. However, the mechanism of action for the secondary benefits to psychological wellbeing, reported in the study, has not been established adequately²⁷.

Whole grains and fibre-related but not synonymous

Historically increasing whole grain intake was recommended because they make an important contribution to dietary fibre intake. However, it is important to note that whole grain does not always equate with high fibre⁷ and the focus in dietary guidance on increasing whole grains intake has not improved levels of fibre consumption²⁰. This is because different whole grains, such as wheat, barley, brown rice, and corn, vary widely in their fibre content.

Thus, public health messages may need to be modified to consider the source of the whole grain and the amount of fibre delivered by the whole-grain products. The American Heart Association (AHA) 2020 Goals classified grain products as

whole grains if the ratio of total carbohydrate to fibre, each in grams per serving, was less than or equal to 10:1, which is approximately the ratio of carbohydrate to fibre in whole wheat flour²⁸. A variety of grain food choices, including whole grains, enriched grains, bran-based grain foods, and other grain-based foods with fibre along with encouraging consumption of fruits, vegetables, and legumes may help close the fibre gap²⁰. The USDA in their 2015-2020 dietary guidelines for Americans states that, “those who consume all of their grains as whole grains should include some grains, such as some whole-grain ready-to-eat breakfast cereals, that have been fortified with folic acid”, keeping in mind the need for folic acid fortification especially for pregnant women¹.

Recommendations for fibre and whole grains

Recommendations to increase consumptions of whole grain is global and guidelines are provided by Australia, Canada, Chile, China, Colombia, Denmark, France, Germany, Greece, Iceland, India, Latvia, Mexico, Oman, Singapore, Switzerland, the United Kingdom, and the United States⁷. Specific recommendations, however, are either primary (that is specific for whole grain) or secondary (made in order to achieve another (primary) target, for example, dietary fibre intake)²⁹. According to the 2015-2020 U.S guidelines, the recommended amount of grains in a 2000 kcal diet is 6oz equivalents (1oz equivalent is 16 g) and at least one half of this amount must be in the form of whole grain. The Dietary guidelines for Indians recommends increasing the consumption of whole grains, legumes, nuts, fruits and vegetables to maintain body weight and body composition³⁰. The Indian Council for Medical Research (ICMR) recommends a daily intake of 40 g of total dietary fibre³¹.

Easy Tip:

To increase the intake of wholegrain and fibre in the diets, choose from a variety of delicious Kellogg's cereals-including All-Bran® Wheat Flakes, Oats, Chocos®, Muesli-that contain whole grain and provides fibre in every bowl.

Key Messages

- Fibre and whole grains are both important components of a healthy, well-balanced diet
- Whole grain foods like whole grain cereals and cereal fibre have been shown to reduce chronic disease risk and overweight
- The essential macro- and micronutrients along with the phytonutrients present in whole grains synergistically contribute to their beneficial effects
- Total dietary fibre is associated with wholegrain and its health benefits
- Among the dietary fibre sources, cereal fibre has shown stronger beneficial associations with non-communicable diseases like T2DM, CVD, hypertension, obesity etc.
- Present-day scientific evidence lends appreciable weightage to the recommendations to incorporate foods containing whole grain and fibre into a healthy diet and lifestyle program

References

1. USDA 2015-2020 Dietary guidelines for Americans.
2. Marc P. McRae (2016) Health Benefits of Dietary Whole Grains: An Umbrella Review of Meta-analyses. *Journal of Chiropractic medicine* Vol16(No.1)p10-18.
3. Mobley A.R. (2013) The Future of Recommendations on Grain Foods in Dietary Guidance. *J. Nutr.* 143: 1527S-1532S, 2013
4. Seal C.J. et al (2016) Whole-grain dietary recommendations: the need for a unified global approach. *British Journal of Nutrition*, 115, 2031-203.
5. Van der Kamp JW, Poutanen K, Seal CJ, et al. (2014) The HEALTHGRAIN definition of 'whole grain'. *Food Nutr Res* 58,
6. Galea, L. M., Dalton, S. M. C., Beck, E. J., Cashman, C. J. & Probst, Y. C. (2016). Update of a database for estimation of whole grain content of foods in Australia. *Journal of Food Composition and Analysis*, 50 23-29.
7. Ferruzzi M.G. et al (2014) Developing a Standard Definition of Whole-Grain Foods for Dietary Recommendations: Summary Report of a Multi disciplinary Expert Roundtable Discussion. *Adv. Nutr.* 5: 164-176.
8. Benisi-Kohansal S. et al (2016) Whole-Grain Intake and Mortality from All Causes, Cardiovascular Disease, and Cancer: A Systematic Review and Dose-Response Meta-Analysis of Prospective Cohort Studies. *Adv Nutr.* Nov; 7(6): 1052-1065.
9. Huang Tao et al (2015) Consumption of whole grains and cereal fibre and total and cause-specific mortality: prospective analysis of 367,442 individuals. *BMC Medicine*(2015)13:59.
10. Wu H. et al (2015) Association Between Dietary Whole Grain Intake and Risk of Mortality Two Large Prospective Studies in US Men and Women. *JAMA Intern Med.* 2015;175(3):373-384.
11. Hollander Pernille LB et al (2015) Whole-grain and blood lipid changes in apparently healthy adults: a systematic review and meta-analysis of randomized controlled studies. *Am J Clin Nutr* 2015;102:556-72.
12. Wang H (2014) Association between statin use and serum cholesterol concentrations is modified by whole-grain consumption: NHANES 2003-2006. *Am J Clin Nutr* 2014;100:1149-57.
13. Cooper D.N. (2017) The Effects of Moderate Whole Grain Consumption on Fasting Glucose and Lipids, Gastrointestinal Symptoms, and Microbiota. *Nutrients* 2017,9,173.
14. Kirwan J.P. (2016) A Whole-Grain Diet Reduces Cardiovascular Risk Factors in Overweight and Obese Adults: A Randomized Controlled Trial. *J Nutr* 2016;146:2244-51.
15. Marventano S. (2017) Whole Grain Intake and Glycaemic Control in Healthy Subjects: A Systematic Review and Meta-Analysis of Randomized Controlled Trials. *Nutrients* 2017,9,769
16. Chanson-Rolle A. et al (2015) Systematic Review and Meta-Analysis of Human Studies to Support a Quantitative Recommendation for Whole Grain Intake in Relation to Type 2 Diabetes. *PLoS ONE* 10(6):e0131377. doi:10.1371/journal.pone.0131377
17. Makarem N (2016) Consumption of whole grains and cereal fibre in relation to cancer risk: a systematic review of longitudinal studies. *Nutrition Reviews* V R Vol. 74(6):353-373.
18. Mourouti N (2015). Dietary patterns and breast cancer: a case-control study in women. *European Journal of Nutrition*, Volume 54, Issue 4, pp 609-617.
19. Knudsen MD (2014) Self-reported whole-grain intake and plasma alkylresorcinol concentrations in combination in relation to the incidence of colorectal cancer. *Am J Epidemiol.* 2014 May 15;179(10):1188-96
20. Karl J.P. (2017) Substituting whole grains for refined grains in a 6-wk randomized trial favorably affects energy-balance metrics in healthy men and post menopausal women. *Am J Clin Nutr* 2017;105:589-99.
21. Vanegas S.M. et al (2017) Substituting whole grains for refined grains in a 6-wk randomized trial has a modest effect on gut microbiota and immune and inflammatory markers of healthy adults. *Am J Clin Nutr* 105:635-50.
22. Gong et al (2017) Whole cereal grains and potential health effects: involvement of the gut microbiota. *Food Research International* 103, 84-102.
23. Baltasar Ruiz-Roso Calvo de Mora. (2015) POSITIVE EFFECTS OF WHEAT BRAN FOR DIGESTIVE HEALTH; SCIENTIFIC EVIDENCE. *Nutr Hosp.* 32(Supl. 1):41-45.
24. Joanne Slavin (2013) Fibre and Prebiotics: Mechanisms and Health Benefits. *Nutrients* 2013, 5, 1417-1435
25. Stevenson L. (2012) Wheat bran: its composition and benefits to health, a European perspective. *International Journal of Food Sciences and Nutrition*, December, 63(8): 1001-1013
26. Jan de Vries et al (2015). Effects of cereal fibre on bowel function: A systematic review of intervention trials. *World J Gastroenterol* 2015 August 7; 21(29): 8952-8963
27. Lawson C.L. et al (2013) Short Term (14 Days) Consumption of Insoluble Wheat Bran Fibre-Containing Breakfast Cereals Improves Subjective Digestive Feelings, General Wellbeing and Bowel Function in a Dose Dependent Manner. *Nutrients* 2013, 5, 1436-1455
28. Mozaffarian R.S. (2013) Identifying whole grain foods: a comparison of different approaches for selecting more healthful whole grain products. *Public Health Nutrition*: 16(12), 2255-2264.
29. Seal C.J. et al (2016) Whole-grain dietary recommendations: the need for a unified global approach. *British Journal of Nutrition* (2016), 115, 2031-2038.
30. National Institute for Nutrition (2011) Dietray guidelines for Indians.
31. ICMR Nutrient requirements and recommended dietary allowance for Indians.
32. Cho SS et al (2013) Consumption of cereal fibre, mixtures of whole grains and bran, and whole grains and risk reduction in type 2 diabetes, obesity, and cardiovascular disease. *Am J Clin Nutr.* 2013 Aug;98(2):594-619.

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