



HEALTHY CEREAL FOODS

HEALTHGRAIN • FORUM

Carbohydrate, fibre and whole grain intake and promotion of nutrition-related health

Cereal foods are an essential part of the daily diet. Nutrition epidemiological research increasingly demonstrates that a diet rich in whole grain and cereal fibre-based foods assists in health maintenance and lowers the risk of nutrition-related diseases. An expert panel of the German Nutrition Society led by Professor Dr. H. Hauner has published an overview of the current scientific evidence covering digestible carbohydrates, dietary fibre and key sources of fibre such as fruits, vegetables and whole grain products. The main findings are presented in this leaflet (source: *Evidence-Based Guideline of the German Nutrition Society: Carbohydrate Intake and Prevention of Nutrition-Related Diseases. Ann Nutr Metab. 2012; 60 (Suppl 1):1-58*).



HEALTHGRAIN Forum

The HEALTHGRAIN Forum was initiated in 2010 to continue the research and communication activities of the EU HEALTHGRAIN project (2005-2010, www.healthgrain.eu), with the over-all aim of increasing consumers' intake of whole grain and its health-protective compounds. Already 60 members joined, with an even balance between academia, research organisations and industry. The Forum, based in Europe and with links worldwide, promotes research according to its strategic research agenda and develops a range of communication activities. This information leaflet is the second developed by the Forum, following the leaflet on health-protective mechanisms of whole grain based on a major review paper by Dr. A. Fardet.

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Carbohydrate intake and prevention of nutrition-related diseases

Evidence-based guideline of the German Nutrition Society

From fibres to sugars: carbohydrates include a wide range of nutrients. What exactly do we know about the role carbohydrates play in the prevention of obesity, type 2 diabetes, cardiovascular diseases and cancer? An expert panel of the German Nutrition Society (Deutsche Gesellschaft für Ernährung = DGE), led by Prof. Dr. Hans Hauner, has provided an overview of the current scientific evidence. According to DGE it has become clear that the quality of carbohydrates is far more important than the quantity. A high dietary fibre intake, especially from whole grain products, decreases the risk of obesity, type 2 diabetes, abnormal concentrations of lipoproteins, coronary heart disease and colorectal cancer. A high intake of sugar-sweetened beverages increases the risk of obesity and type 2 diabetes. To that end, the authors advice to focus on two dietary recommendations: stimulating dietary fibre intake, especially the intake of whole grain products, and reducing the consumption of sugar-sweetened beverages.

In recent years, more and more research has been carried out to establish the connection between carbohydrates and health. While research has been carried out mainly in the form of prospective cohort studies, randomised intervention studies are not yet available in all fields. In the publication, a total of 248 studies were examined according to standard scientific procedures for systematic literature reviews. The strength of the evidence was judged as "convincing", "probable", "possible" and "insufficient" following a scheme of the WHO. Classifications were assigned based on the number, type and quality of the studies. Only a few relations, or the absence thereof, were found to be supported by convincing evidence.

Carbohydrate intake no influence on nutrition-related diseases

The authors found little evidence that the energy percentage of carbohydrates in the diet affects the risk of nutrition-related health conditions. There is convincing evidence that there is no association between total carbohydrate intake and the risk of type 2 diabetes. The authors found it probable that there is no association between carbohydrate intake and obesity either. An increase in dietary carbohydrate intake does not show any long-term effect on the development of obesity. The available data also indicate that carbohydrate intake does not influence the risk of cancer. For the time being, this applies to colorectal cancer as well, although two recent studies associate a high carbohydrate intake with reduced risk of colorectal cancer. The authors did not find a relation between the intake of monosaccharides, disaccharides and polysaccharides and the risk of nutrition-related diseases, with one exception: there is possible evidence that a high intake of monosaccharides increases the risk of pancreatic cancer.



Effects on serum lipid profile but not on coronary heart disease

Thus, the total dietary carbohydrate intake seems to have no effect on the development of nutrition-related diseases. Nevertheless, there is convincing evidence that a higher carbohydrate proportion in the diet at the expense of total fat intake has an effect on the serum lipid profile. To separate the effects of dietary fibre intake and the effects of carbohydrate intake, the authors only permitted studies in which the higher carbohydrate intake did not go hand in hand with an increase in dietary fibre intake of more than 7 grams per day. When the intake of carbohydrates increases at the expense of total fat or saturated fatty acid intake, concentration of total cholesterol, LDL-cholesterol and HDL-cholesterol decreases. An increase in carbohydrate intake at the expense of polyunsaturated fatty acids, on the other hand, results in an increase in the concentrations of total and LDL cholesterol and a decrease of HDL cholesterol. The exchange of carbohydrates for monounsaturated fatty acids has no effect on total cholesterol and LDL cholesterol, while the concentration of HDL cholesterol decreases. The triglyceride concentration increases whatever type of fat is exchanged for carbohydrates. The effects of dietary fatty acids and carbohydrates on the ratio of serum total to HDL cholesterol were also examined. This ratio remains the same when carbohydrates replace saturated fatty acids and decreases when carbohydrates replace mono- or polyunsaturated fatty acids. More research is needed before any conclusions can be drawn on the effects of specific groups of carbohydrates on serum lipid concentrations. The authors do however conclude that there is possible evidence that there is no association between a higher carbohydrate intake and the risk of coronary heart disease.

Encourage dietary fibre intake

Fibre is the only type of carbohydrates for which evident health benefits are found. The authors conclude that in general a high dietary fibre intake has positive effects on human health. It reduces the risk of obesity, hypertension and coronary heart disease with probable evidence and the risk of colorectal cancer and abnormal concentrations of lipoproteins with possible evidence. The effects do seem highly dependent on the quality and source of the fibre. There is convincing evidence that an increase in the intake of soluble dietary fibre like β -glucan from barley and oatmeal lowers the concentrations of total and LDL cholesterol. There is possible evidence that they reduce the risk of coronary heart disease as well. There is probable evidence that consumption of whole grain products reduces the risk of type 2 diabetes, whereas the intake of total dietary fibre does not seem to have an effect here.

Positive effects of whole grain products

The authors also found convincing evidence of the effects of whole grain products on the serum lipid profile. A high consumption of whole grain products lowers concentrations of total and LDL cholesterol and has no influence on concentrations of HDL cholesterol and triglycerides. Whole grain products seem to have further positive health benefits, although there is no convincing evidence yet. A high consumption of whole grain products reduces the risk of type 2 diabetes, hypertension and coronary heart disease with probable evidence and obesity with possible evidence. The consumption of fibre from grains was also found to have positive effects on reducing the risk of colorectal cancer (probable) and stomach cancer (possible). According to another review on the health effects of whole grain products, these effects can only be partially attributed to the presence of dietary fibre (source: Fardet, 2010). To increase the consumption of whole grain products, Hauner et al. recommend choosing whole grain variants of bread, pasta and other cereal products.

Reduced consumption of sugar-sweetened beverages

More research is needed on the influence of carbohydrates other than fibre, such as mono-, di- and polysaccharides. Sugar-sweetened

beverages are an exception: they have been studied extensively. High consumption of sugar-sweetened beverages increases the risk of type 2 diabetes with probable evidence and increases the risk of metabolic syndrome with possible evidence. The authors recommend a reduced consumption of sugar-sweetened beverages and promote the consumption of sugar-free and low calorie alternatives. Drinking water or mineral water and sugar-free herbal and fruit teas are the best alternatives.

Glycaemic Index and Glycaemic Load

The authors do not make recommendations regarding the Glycaemic Index (GI) or Glycaemic Load (GL) of foods, as they found no convincing evidence to support any recommendations. High GI foods do, however, increase concentrations of total cholesterol with probable evidence and increase the risk of type 2 diabetes with possible evidence. High GL foods increase concentrations of triglycerides with probable evidence. And finally, possible relations between high GI and a higher risk of obesity and coronary heart disease were only found for women.

Table 3. Summary of the evidence regarding the association between carbohydrate intake and primary prevention of certain nutrition-related diseases

Risk of	Increase in:	Carbohydrate proportion	Monosaccharides	Disaccharides	Sugar-sweetened beverages	Polysaccharides	DF/whole grain products	GI	GL
Obesity									
Adults		○○	~	~	↑↑	-	total DF: ↓↓ whole grain products: ↓	↑ ^h /~ ⁱ	○
Children		○○	~	~	↑	-	total DF: ○ whole grain products: ~	~	~
Type 2 diabetes mellitus		○○○	~	~/ ^o ○ ^g / ^f	↑↑	~	total DF: ○ whole grain products: ↓↓ DF from cereal products: ↓↓	↑	○
Dyslipoproteinaemia									
Total cholesterol concentration		↓↓↓ ^a , ↑↑↑ ^b	~	~	~	~	total DF: ↓ whole grain products: ↓↓↓	↑↑	~
LDL cholesterol concentration		↓↓↓ ^a , ↑↑↑ ^b	~	~	~	~	total DF: ↓ whole grain products: ↓↓↓	~	~
HDL cholesterol concentration		↓↓↓ ^a , ↓↓↓ ^b	~	~	~	~	total DF: ○○ whole grain products: ○○○	○○○	~
Triglyceride concentration		↑↑↑	○○ ^c	~	~	~	total DF: ○○○ whole grain products: ○○○	○○	↑↑
Hypertension		○	○ ^d	○ ^g	○	~	total DF: ↓↓ whole grain products: ↓↓	~	~
Metabolic syndrome		~	-	-	↑	-	total DF: ○ whole grain products: ~	-	-
CHD		○	~	~	~	~	total DF: ↓↓ whole grain products: ↓↓ DF from cereal products: ↓	↑ ^h /○ ⁱ	↑ ^h /○ ⁱ
Cancer									
Oesophagus		~	~	~	-	~	~	~	~
Stomach		○	-	-	-	○	total DF: ~ DF from cereal products: ↓	~	~
Colorectum		○	~	○	○	○	total DF: ↓ DF from cereal products: ↓↓	↑	○
Breast		○	~	○	-	~	○	○	○○
Endometrium		○	-	~	-	~	~	○	↑
Pancreas		○	↑	○	○	○	~	○	○

DF = Dietary fibre. ^a At increased carbohydrate proportion at the expense of total fat or saturated fatty acids, respectively. ^b At increased carbohydrate proportion at the expense of polyunsaturated fatty acids. ^c At fructose up to 100 g/d, other monosaccharides ~. ^d At long-term fructose intake. ^e Sucrose. ^f Lactose. ^g Long-term sucrose intake. ^h Women. ⁱ Men.

The number of arrows only indicates the level of evidence of the data and not the extent of the risk.

↑ = Possible evidence, risk-enhancing; ↑↑ = probable evidence, risk-enhancing; ↑↑↑ = convincing evidence, risk-enhancing.

↓ = Possible evidence, risk-reducing; ↓↓ = probable evidence, risk-reducing; ↓↓↓ = convincing evidence, risk-reducing.

○ = Possible evidence, no association; ○○ = probable evidence, no association; ○○○ = convincing evidence, no association.

~ = Insufficient evidence.

- = No study identified.

Need for further research

Although most studies on the health effects of carbohydrates have been conducted in relation to obesity, even in this field more research is needed. The authors are particularly interested in studies on the effects of sucrose and added sugar and in research among children and adolescents. In addition, more intervention studies are needed on the effects of an increased consumption of whole grain foods on obesity, type 2 diabetes and coronary heart disease. There is also a lack of prospective studies that investigate the association between the intake of dietary fibre and pancreatic cancer. This lack of data is inexplicable because of the potential importance of dietary fibre intake for the prevention of cancer in organs related to glucose metabolism, like the pancreas. Finally, the authors note that when studying carbohydrate intake in association with chronic diseases it is important to bear in mind that overall risk is determined only by the interaction of various food components, and therefore, the importance of the individual components should not be overestimated.



Acknowledgements

The HEALTHGRAIN Forum would like to thank Professor Dr. Hauner and the German Nutrition Society for approving of the publication of this summary.

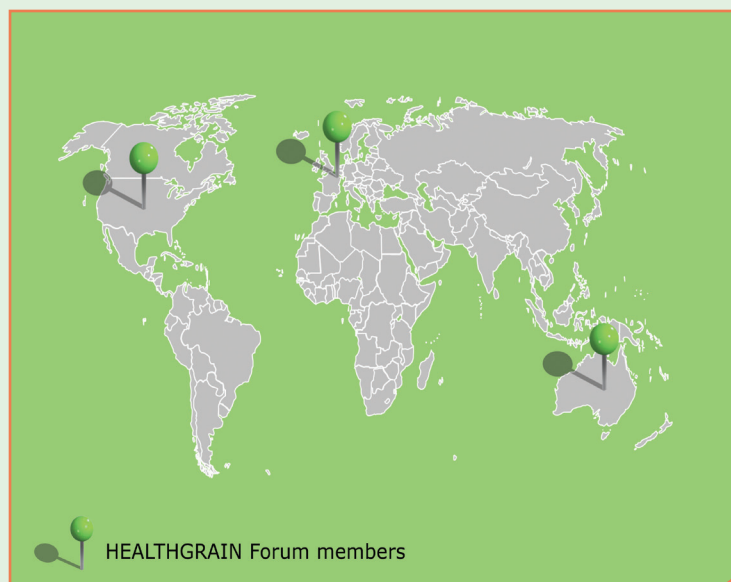
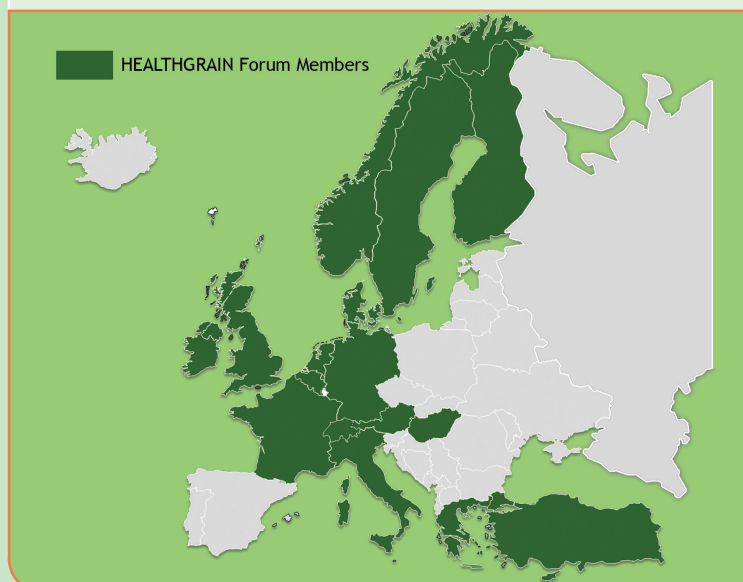
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Hauner H, Bechtold A, Boeing H, Brönstrup A, Buyken A, Leschik-Bonnet E, Linseisen J, Schulze M, Strohm D, Wolfram W. Evidence-Based Guideline of the German Nutrition Society: Carbohydrate Intake and Prevention of Nutrition-Related Diseases. *Ann Nutr Metab* 2012; 60 (Suppl 1):1-58 DOI: 10.1159/000335326

For more information see:

HEALTHGRAIN Forum, Health-protective Mechanisms of Whole grain Cereals – New Hypotheses (2011) http://www.healthgrain.org/webfm_send/257/1
EUFIC, Whole grain Fact Sheet (2009) <http://www.eufic.org/article/en/expid/Whole-grain-Fact-Sheet>

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