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# NUTRINEWS

*In the current issue, we look at the association of regular breakfast consumption and reduction of non-communicable diseases like Type 2 Diabetes Mellitus (T2DM), Hypertension, Cardiovascular diseases (CVD), Cancer etc.*

*Most cross-sectional studies with few intervention studies have shown that consuming wholegrain and high-fibre breakfast cereals is associated with reduced risk of chronic diseases. In particular, high fibre and whole grain breakfast cereals have shown to be beneficial. Hence, breakfast cereal consumption can be looked at being a marker of an overall healthy lifestyle.*

*In summary, this newletter provides a comprehensive scientific view on benefits of breakfast cereal for promoting good dietary habits and gealthier lifestyles.*

*As always, we welcome your valuable feedback and comments.*

*Happy reading!*

**Regards,**
**Kellogg's® Nutrition Team.**

## *Role of regular consumption of breakfast cereals in reducing risk of:*

### *1. Cardiovascular diseases (CVD) and metabolic syndrome*

Breakfast cereal consumption, in particular is linked with reduced cardio-metabolic risk. Results from the NHANES: 1999-2006 state that 'Young adults who consumed ready-to-eat cereals (RTEC) demonstrated reduced chance/risk of developing cardio-metabolic diseases'.[1]

Compared to breakfast skippers, RTEC consumers were 37%, 28%, 23%, 40% and 42% less likely to have high blood pressure, high serum total cholesterol, high serum LDL-cholesterol, reduced serum HDL-cholesterol and lowered insulin response, respectively. RTEC consumers were respectively 24% and 84% less likely to have elevated blood pressure and elevated glycosylated hemoglobin (HbA1C) relative to other breakfast consumers.[1]

Yoo KB et al [2] found that consumption of either a dairy-cereal breakfast or a high energy and fibre-based breakfast was associated with a reduced incidence of metabolic syndrome in more than 16,000 subjects who participated in Korea National Health and Nutrition Examination Survey (KNHANES) 2007-2009.

Several meta-analyses conducted on the use of whole-grain cereals have reported reduced risk of coronary heart disease associated with whole-grain consumption, ranging from 19% to 30% risk-reductions with intakes of ≥ 3 servings/day.[3-7]

Similarly, another meta-analysis reports the significant effect of dietary fibre in decreasing blood total-cholesterol and LDL-cholesterol which is associated with the specific consumption of oats and psyllium.[8]

A 12 week study in overweight Taiwanese subjects reported a 10% reduction in total and LDL cholesterol when two servings of oat cereals were consumed per day.[9] In another 12 week U.S. study including 204 overweight and obese adults, the authors found that two portions/day of ready-to-eat oat cereal lowered total-cholesterol by 5.4% and non-HDL cholesterol by 6.3%.[10] In Australia, a 6 week trial in mildly hyper-cholesterolemic men and women achieving the consumption of 3.2 g of beta-glucan/day in over two servings of oat-based porridge or cereal bars resulted in reduction of 7.8% in total-cholesterol and 8.4% in LDL-cholesterol.[11]

Another recent meta-analysis concluded that insoluble fibre from cereal sources is inversely associated with risk of coronary heart disease and CVD.

Giacco R, et al.[13] found that consumption of whole-grain products reduced postprandial insulin response by (29%) and triglyceride plasma concentrations by (43%) - two important markers for T2DM and CVD (Figure 1&2).

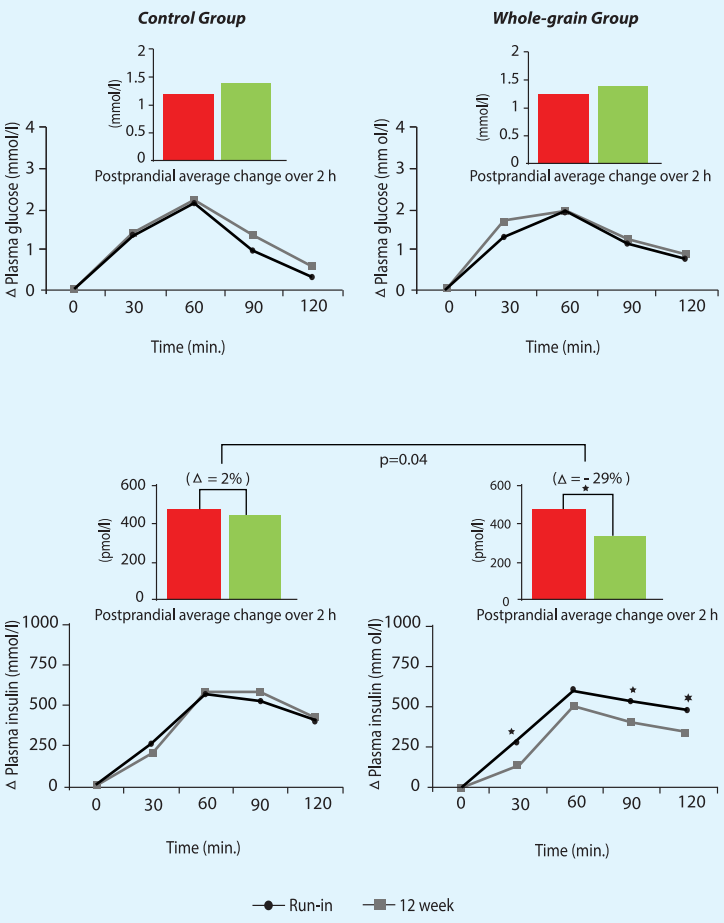


**Figure 1.** Postprandial plasma glucose and insulin concentrations after run-in and intervention periods (mean values); *p < 0.05[13]

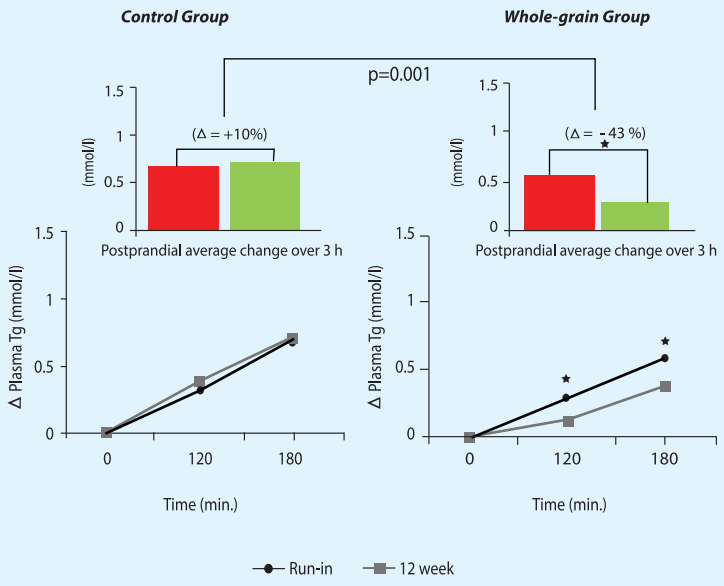


**Figure 2.** Postprandial plasma triglyceride concentrations after run-in and intervention periods (mean values); *p < 0.05 paired sample[13]

### *Position statement of the American Society for Nutrition (ASN), 2013 states that -*

"Based on the current state of the science, consumption of foods rich in cereal fiber or mixtures of whole grains and bran is modestly associated with a reduced risk of obesity, T2D, and CVD. The data for whole grains alone are limited primarily because of varying definitions among epidemiologic studies of what, and how much, was included in that food category."[14]

In summary, evidence from randomized controlled trials and meta-analyses supports the relationship between consumption of breakfast cereals as sources of soluble fibre (from oats, barley, and psyllium) with improved cardiovascular lipid profiles-specifically by lowering total and LDL cholesterol-despite having very limited effect on HDL cholesterol levels. In addition, most case control studies seem to support a protective effect for whole-grain breakfast cereals.

## *2. Type 2 Diabetes Mellitus (T2DM) and glucose intolerance*

### *T2DM risk reduction data:*

The U.S. Physicians' Health Study I was the largest prospective study in the meta-analysis conducted by Kochar J, et al. This study examined the association between breakfast cereal consumption and the risk of development of T2DM in 21,152 U.S. male participants. The results showed that a higher consumption (≥7 servings /week) of breakfast cereals was significantly associated with a risk-reduction of T2DM, but the protective effect was stronger in individuals consuming whole-grain cereals than in those consuming refined cereals. This additional positive effect was explained by a possible attenuation of glycemic response due to higher content of fibre, antioxidants, magnesium and vitamin E in the wholegrain breakfast cereals.[15]

Systematic review of the prospective cohort studies in 161,737 women (aged 26 - 46 years) showed an inverse association between whole-grain intake and risk of T2DM. Based on a meta-analysis of six cohort studies, a two-servings-per-day increment in whole-grain intake was associated with a 21% decrease in risk of T2DM.[16]

The Cochrane systematic review and meta-analysis reported that a high cereal fibre intake, after adjusting for confounding variables such as body mass index and family history of diabetes, reduces the risk of developing T2DM by 28 to 37%. Importantly, the findings indicate that risk reduction is achievable through approximately 8 gram greater intake of cereal fibre, an amount which can be attained with consumption of variety of foods.[17]

Three prospective studies in 160,000 men and women showed that risk for developing type 2 diabetes was 21-27% lower with whole grain intake, and 30-36% lower with cereal-fibre intake.[18]

### *Glucose control data:*

A small cross-sectional Malaysian study in diabetic subjects found an association between oat consumption and better blood glucose control.[19]

Several studies have reported improved glucose or insulin responses with oat-, barley-, or psyllium-based cereal or muesli breakfasts compared with other breakfast cereals in diabetic subjects and the effect was also seen in some studies in normal subjects when cereals with beta-glucan were studied. In normo-glycemic subjects, high-fibre breakfast cereals seemed to reduce postprandial plasma glucose responses.[20]

### *Effect on metabolic syndrome:*

According to the analysis of 2001-2008 NHANES data, eating RTEC is associated with lower body weight, lower BMI, reduced abdominal diposity and lower prevalence of metabolic syndrome in adults aged 19 to 51 years.[21]

## 3. Hypertension

Specific evidence examining the relationship between breakfast cereals and hypertension currently remains limited to a few studies.

The most significant results are from the Physician's Health Study 1, which showed a 19% reduction in hypertension risk with daily breakfast cereal consumption and a stronger association with whole-grain than with refined-grain cereals. The authors suggested that a number of components in cereals-including folate, magnesium, potassium, and fibre-may be responsible for this protective effect.[22]

In the NHANES 1999-2006[1], the consumers of RTEC at breakfast were 24% less likely to have hypertension.

Cereal fibre consumption was inversely associated with a lower risk of hypertension in a Spanish cohort. The effect was more prominent in men and obese and older individuals.[23]

## 4. Colorectal cancer

A 2011 systematic review and meta-analysis of 25 prospective cohort, case-cohort, or nested case-control design studies analysed the risk reduction for different fibre types. The review included more than 1.9 million participants and found a significant protective effect for cereal fibre on colorectal cancer. Each 10 gram increase in cereal fibre was estimated to reduce the risk of colorectal cancer by 10%.[24]

Contrary to popular dietetic advice, the relative risk reduction for fruit, vegetable and legume fibre was not significant (Figure 3).[24]

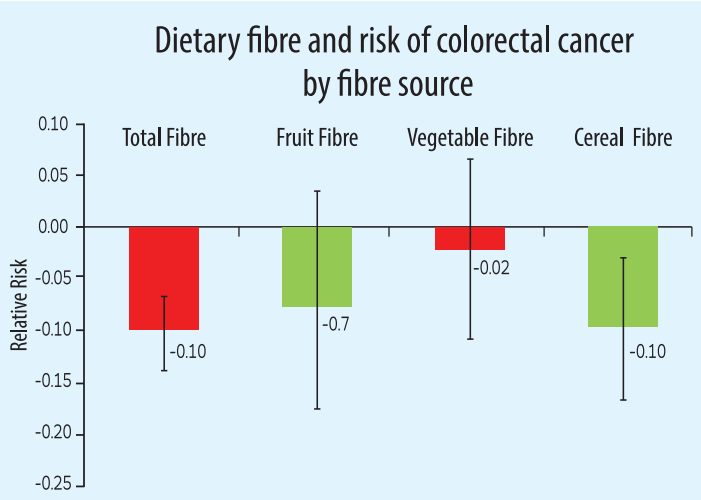


**Figure 3.** Summary of reduced risk of 25 prospective studies for 10g daily increase in total fibre, fruit fibre, vegetable fibre and cereal fibre. Both total fibre and cereal fibre, but not fruit or vegetable fibre, are associated with a significant risk reduction.

An inverse association was found between whole grain consumption and risk of colon cancer in a large population-based prospective cohort of Swedish women. The decrease in risk was 35% when comparing the extreme categories of whole grain consumption, and the same was reduced to 25% after additional adjustment for cereal fibre. This suggests that the observed reduction in colon cancer risk associated with high consumption of whole grains may partly be attributed to cereal fibre but that other constituents like phenolic compounds; phytoestrogens etc. may contribute to further protection.[25]

The European Prospective Investigation into Cancer and Nutrition (EPIC) reported significant inverse associations between intake of fibre from cereals and fruits and risk of colon cancer among over 500 000 participants from 10 European countries.[26]

Findings from another large population-based Scandinavian HELGA cohort showed that intake of whole-grain products was associated with a lower incidence of colorectal cancer per 50 g increment and the same tendency was found for total whole-grain intake.[27]

## *Key take outs:*

- Extensive scientific data is currently available that supports the linkage between regular breakfast cereal consumption and reducing risk of developing chronic diseases
- Regular consumption of whole grain and high fibre breakfast cereals is associated with a reduced risk of developing CVD, T2DM and incidence of colorectal cancer
- Regular consumption of oat-, barley- or psyllium-based breakfast cereals can help lower total and LDL cholesterol levels
- Cereal fibre intake is associated with lower risk of developing T2DM and CVD
- Ready-to-eat breakfast cereals provide protein and fibre. They are generally low fat, have fewer calories yet nutrient-dense and therefore can be recommended as part of a healthy balanced diet

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