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Health benefits of wholegrain: a systematic review of the scientific evidence to propose a daily intake

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Background and Objectives:

Recommendation to include **wholegrain (WG)** in the daily diet is widespread but is rarely quantitative. This poster presents the first step of a work which attempts to **systematically review the published human studies** aiming at identifying the **daily intake of WG associated to favorable health outcomes**. We describe here the **results related to type 2 diabetes (T2D)**.

Methods:

PubMed and Cochrane Library were searched from 01/01/1993 to 12/31/2012. Because of the global objective of this work, key words related to several health outcomes (overall mortality, obesity, cardiovascular diseases, T2D and associated risk factors) were used. Observational and intervention studies were considered. Study selection and data extraction were performed by two PhD and one nutritionist (**figure 1**). WG intakes were standardized in g/d of **WG ingredients (WGI)** by using the following assumption[1]:

- 1 serving of WG food = 30g
- WG foods contain on average 51% of WGI

A meta-analysis (MA) of the extracted data was performed in order to **explore the quantitative relationship between WGI intake and the risk of T2D**. Meta-regressions of T2D rates on WGI amounts were performed by using a hierarchical mixed linear model, with exploration of covariates [sex, age, country, study design, mode of report of WG intake (food or ingredient), duration of follow up]. All statistical analyses were performed on SAS 9.2. Missing information was requested from the authors when needed. If no appropriate answer was received and if the missing information could not be calculated from the publication, the study was excluded from the MA.

Subset of key words used in the literature search.

WG-related key words	AND	T2D-related key words
WG OR bran OR individual cereal name (wheat / rye / barley / oat…) NOT (germ / aleurone)		Diabetes / insulin sensitivity / hyperglycemia / glucose tolerance

Results and Discussion:

Characteristics of studies considered for MA on T2D risk:

- **6 studies :** 4 US, 1 Iranian and 1 Finnish.
- **238 559 subjects** in total.
- 5 prospective cohorts (6 to 22 y of follow up) and 1 cross-sectional analysis.
- WGI consumption ranged from 2 to 154 g/d (median of 19 g/d). The 4 US studies had similar ranges from a few g to 40-50 g/d, while the other studies reached much higher intake levels (117 g/d in the Iranian study and 154 g/d in the Finnish study).

Meta-regression:

- **Significant association between WGI consumption and occurrence of T2D (p<0.0001)**, with a slope of -0.000308 (95% CI: [-0.000462, -0.000154]), i.e. an overall **reduction of 0.03% in the incidence of T2D for each additional g of WGI consumed daily** (**figure 2**).
- Secondary analyses showed that the results are robust with regard to either exclusion of each study at a time or accounting for all tested covariates. Observed results did not show evidence of between-study heterogeneity (Cochran Q statistic ; Q = 0.11, p=0.99).

Discussion:

- **Increasing WGI intake from 7.5 g/d** (~1/2 serving of WG food) **to 45 g/d** (~3 servings of WG food) would result in a **relative risk reduction of 21%.**
- As a comparison, **lifestyle modifications** regarding diet and exercise such as those applied in the US Diabetes Prevention Program have been shown to **decrease the risk of T2D by ~ 58% in individuals at high risk of T2D**[2].
- Subjects considered in our MA were not at risk of T2D, and therefore, **a risk reduction of 21%** can be considered as **clinically relevant.**

Figure 1: Flow diagram of study selection

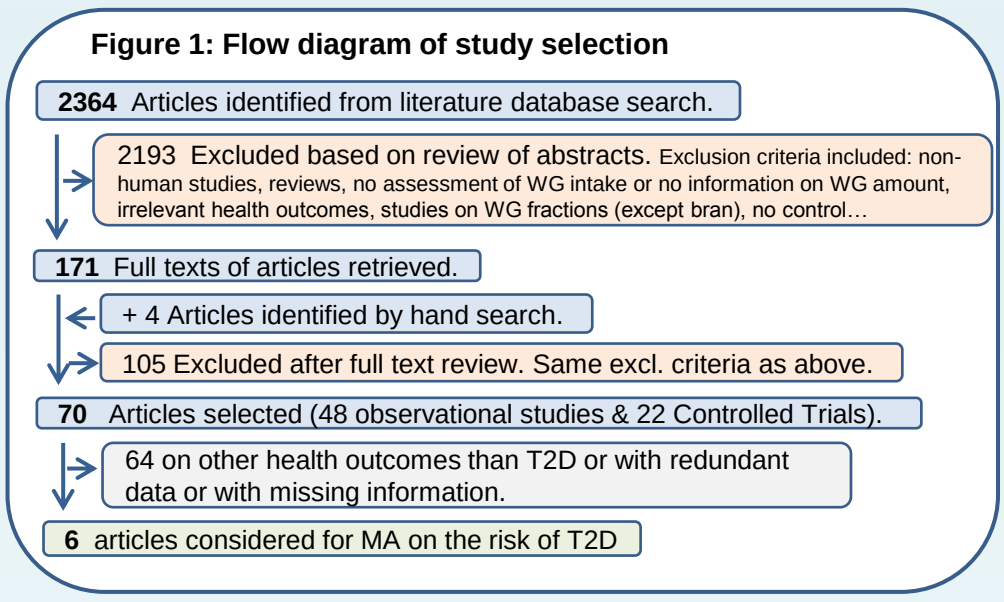
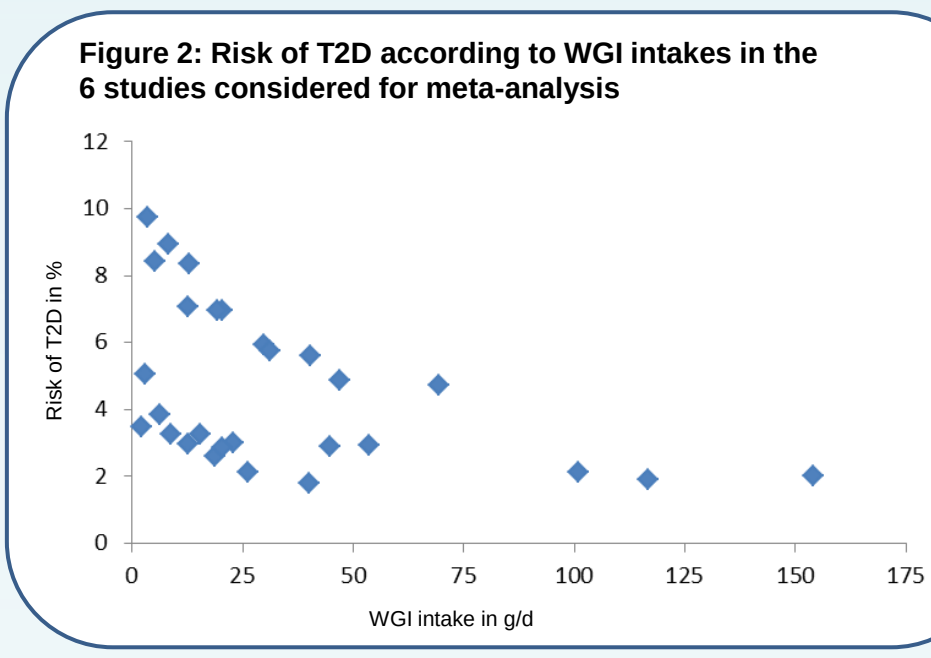


Figure 2: Risk of T2D according to WGI intakes in the 6 studies considered for meta-analysis



Conclusions:

On the 6 studies analyzed, **a clear and statistically significant relationship between WG consumption and occurrence of T2D** has been observed. This suggests that **any increase in WG intake would be beneficial toward the prevention of T2D**. According to the model defined in the MA, and as an example of calculation, **consuming 45 g/d of WG ingredients (3 servings of WG food) would decrease the risk of T2D by 21%** as compared to consuming 7,5 g/d of WG ingredients (a half serving of WG food), which can be considered as **clinically relevant** for a population not at risk of T2D. These data could contribute to set up a **recommended daily intake of WG** and could be **complemented with data on other health outcomes** for which similar analyses are ongoing.

Keywords: wholegrain, dietary intake recommendation, type 2 diabetes

References: **1** US Food and Drug Administration. Center for Food Safety and Applied Nutrition: A Food Labeling Guide. 1994, Docket 99P-2209. Health Claim Notification for Wholegrain Foods. **2** Reduction in the Incidence of Type 2 Diabetes with Lifestyle Intervention or Metformin. New England Journal of Medicine 2002;346(6):393-403.

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