

# THE LANCET

## Carbohydrate quality and human health: a series of systematic reviews and meta-analyses

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## Summary

### Background

Previous systematic reviews and meta-analyses explaining the relationship between carbohydrate quality and health have usually examined a single marker and a limited number of clinical outcomes. We aimed to more precisely quantify the predictive potential of several markers, to determine which markers are most useful, and to establish an evidence base for quantitative recommendations for intakes of dietary fibre.

### Methods

We did a series of systematic reviews and meta-analyses of prospective studies published from database inception to April 30, 2017, and randomised controlled trials published from database inception to Feb 28, 2018, which reported on indicators of carbohydrate quality and non-communicable disease incidence, mortality, and risk factors. Studies were identified by searches in PubMed, Ovid MEDLINE, Embase, and the Cochrane Central Register of Controlled Trials, and by hand

searching of previous publications. We excluded prospective studies and trials reporting on participants with a chronic disease, and weight loss trials or trials involving supplements. Searches, data extraction, and bias assessment were duplicated independently. Robustness of pooled estimates from random-effects models was considered with sensitivity analyses, meta-regression, dose-response testing, and subgroup analyses. The GRADE approach was used to assess quality of evidence.

## Findings

Just under 135 million person-years of data from 185 prospective studies and 58 clinical trials with 4635 adult participants were included in the analyses. Observational data suggest a 15–30% decrease in all-cause and cardiovascular related mortality, and incidence of coronary heart disease, stroke incidence and mortality, type 2 diabetes, and colorectal cancer when comparing the highest dietary fibre consumers with the lowest consumers. Clinical trials show significantly lower bodyweight, systolic blood pressure, and total cholesterol when comparing higher with lower intakes of dietary fibre. Risk reduction associated with a range of critical outcomes was greatest when daily intake of dietary fibre was between 25 g and 29 g. Dose-response curves suggested that higher intakes of dietary fibre could confer even greater benefit to protect against cardiovascular diseases, type 2 diabetes, and colorectal and breast cancer. Similar findings for whole grain intake were observed. Smaller or no risk reductions were found with the observational data when comparing the effects of diets characterised by low rather than higher glycaemic index or load. The certainty of evidence for relationships between carbohydrate quality and critical outcomes was graded as moderate for dietary fibre, low to moderate for whole grains, and low to very low for dietary glycaemic index and glycaemic load. Data relating to other dietary exposures are scarce.

## Interpretation

Findings from prospective studies and clinical trials associated with relatively high intakes of dietary fibre and whole grains were complementary, and striking dose-response evidence indicates that the relationships to several non-communicable diseases could be causal. Implementation of recommendations to increase dietary fibre intake and

to replace refined grains with whole grains is expected to benefit human health. A major strength of the study was the ability to examine key indicators of carbohydrate quality in relation to a range of non-communicable disease outcomes from cohort studies and randomised trials in a single study. Our findings are limited to risk reduction in the population at large rather than those with chronic disease.