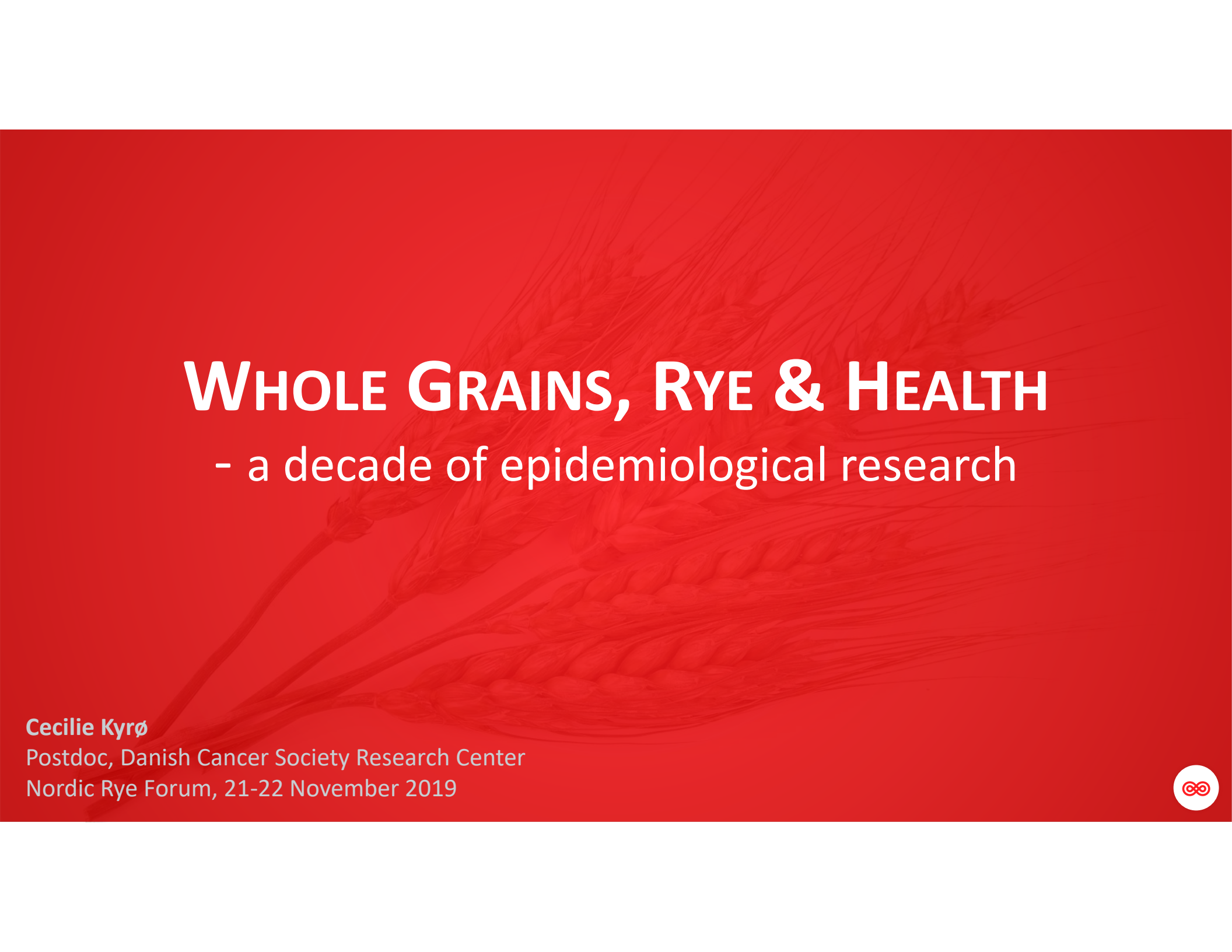




WHOLE GRAINS, RYE & HEALTH

- a decade of epidemiological research

Cecilie Kyrø

Postdoc, Danish Cancer Society Research Center

Nordic Rye Forum, 21-22 November 2019



Whole Grains & risk of chronic diseases



The HELGA project, 2007-2012

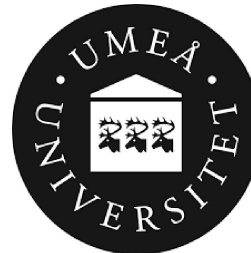
Projects and spin-offs



Danish Cancer Society | RESEARCH CENTER



UNIVERSITY OF
COPENHAGEN



UNIVERSITY OF
EASTERN FINLAND



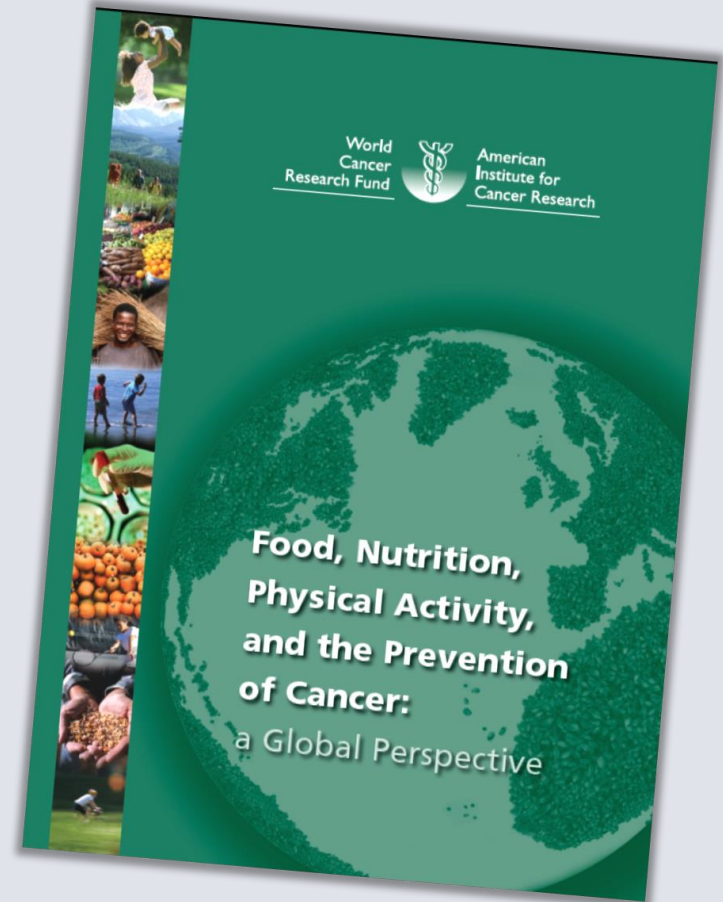
NordForsk



Prevention of Colorectal Cancer

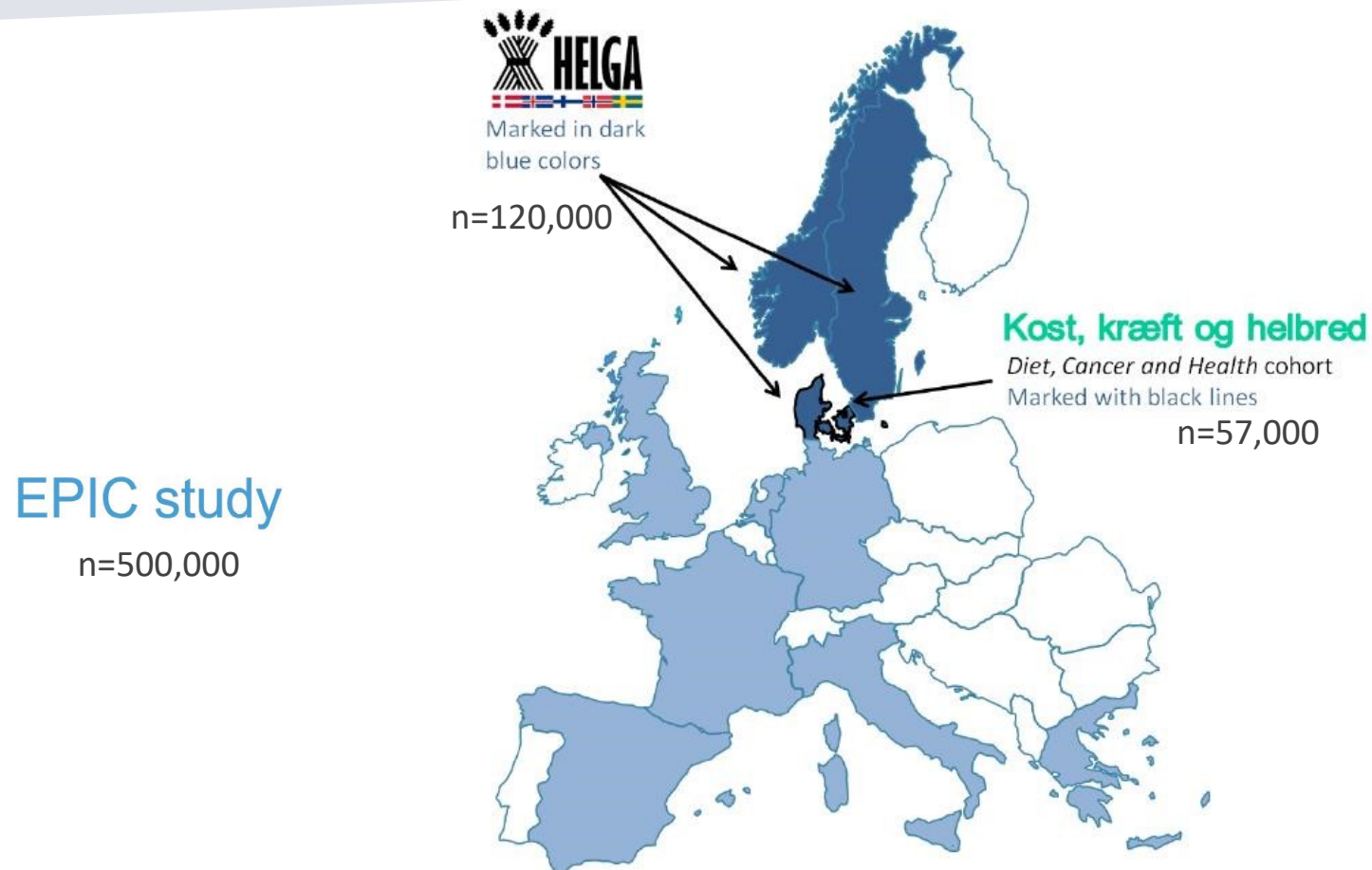
FOOD, NUTRITION, PHYSICAL ACTIVITY, AND CANCERS OF THE COLON AND THE RECTUM		
In the judgement of the Panel, the factors listed below modify the risk of cancers of the colon and the rectum. Judgements are graded according to the strength of the evidence.		
	DECREASES RISK	INCREASES RISK
Convincing	Physical activity ¹²	Red meat ^{2,4} Processed meat ^{4,5} Alcoholic drinks (men) ⁶ Body fatness Abdominal fatness Adult attained height ⁷
Probable	Foods containing dietary fibre ⁸ Garlic ⁹ Milk ^{10,11} Calcium ¹²	Alcoholic drinks (women) ⁶
Limited — suggestive	Non-starchy vegetables ⁹ Fruits ⁹ Foods containing folate ⁸ Foods containing selenium ⁸ Fish Foods containing vitamin D ^{8,13} Selenium ¹⁴	Foods containing iron ^{4,8} Cheese ¹⁰ Foods containing animal fats ⁸ Foods containing sugars ¹⁵
Limited — no conclusion	Cereals (grains) and their products; potatoes; poultry; shellfish and other seafood; other dairy products; total fat; fatty acid composition; cholesterol; sugar (sucrose); coffee; tea; caffeine; total carbohydrate; starch; vitamin A; retinol; vitamin C; vitamin E; multivitamins; non-dairy sources of calcium; methionine; beta-carotene; alpha-carotene; lycopene; meal frequency; energy intake	
Substantial effect on risk unlikely	None identified	

World Cancer Research Fund / American Institute for Cancer Research (WCRF/AICR), 2007



Cohorts

Diet, Cancer and Health, HELGA & EPIC



Research Projects

Methods

Questionnaire data

- Colorectal cancer (HELGA, 1100 cases)
- Myocardial infarction (DCH, 2300 cases)
- Diabetes (DCH, 7000 cases)
- Mortality (HELGA, 7800 deceased)



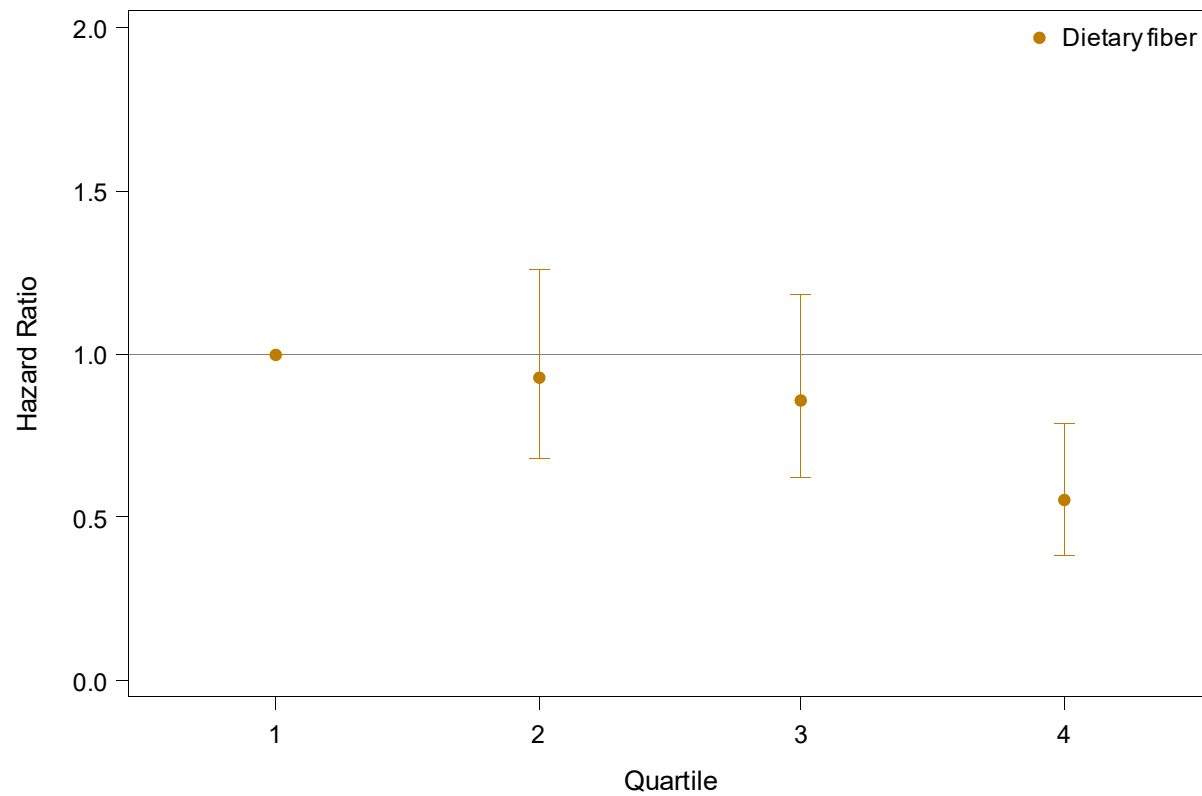
Biomarkers Alkylresorcinols

- **Plasma from EPIC cohort:**
1372 colorectal cases and 1372 matched controls (nested case-control design)
- **Plasma from DK and SE**
975 matched case-control pairs
- **Adipose tissue from DCH cohort:**
414 breast cancer cases, 933 sub-cohort (case-cohort design)



Studies on colorectal cancer

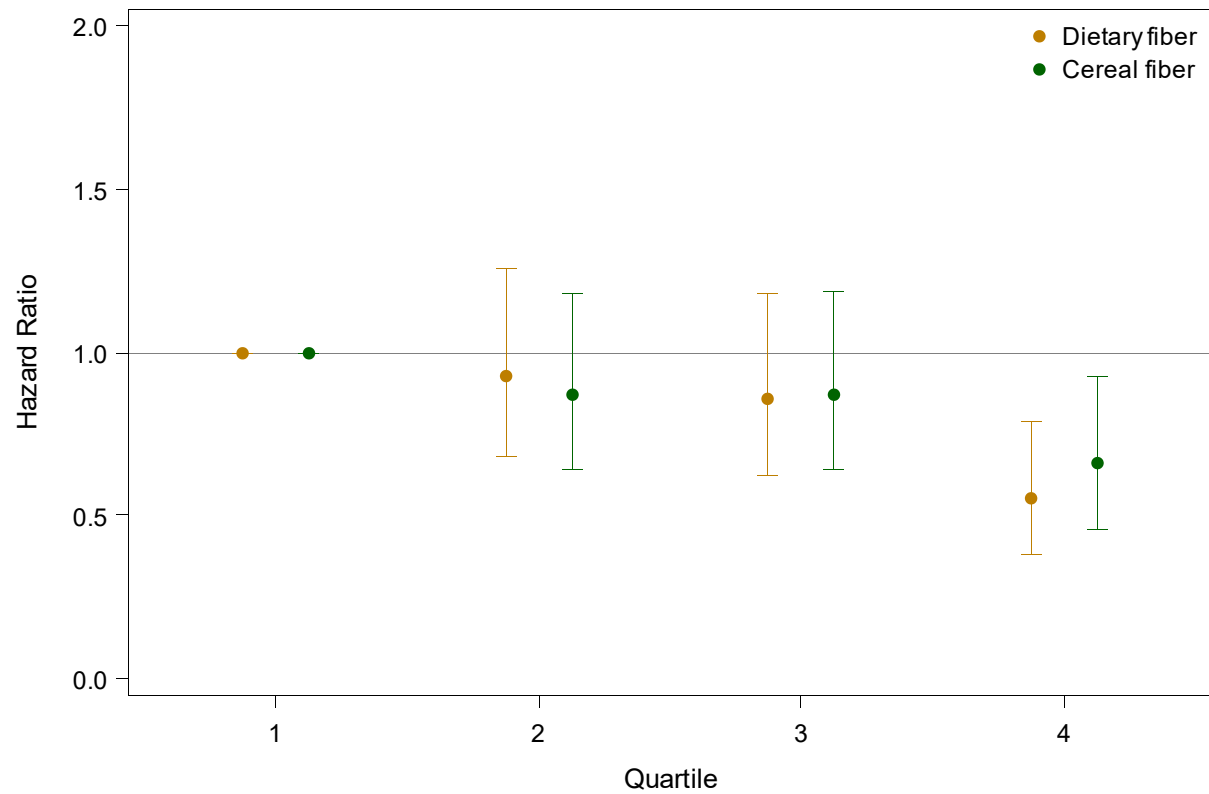
Men



Hansen L *et al.* Int J Cancer 2012

Studies on colorectal cancer

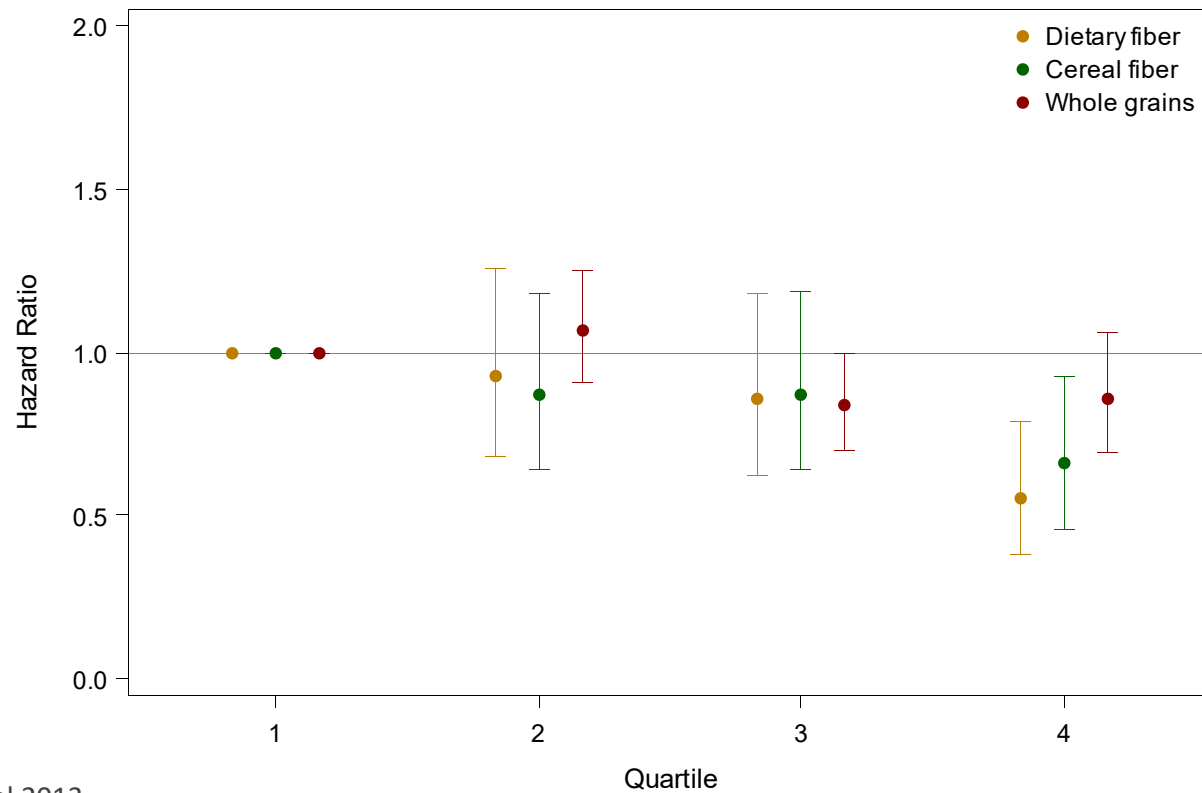
Men



Hansen L *et al.* Int J Cancer 2012

Studies on colorectal cancer

Men

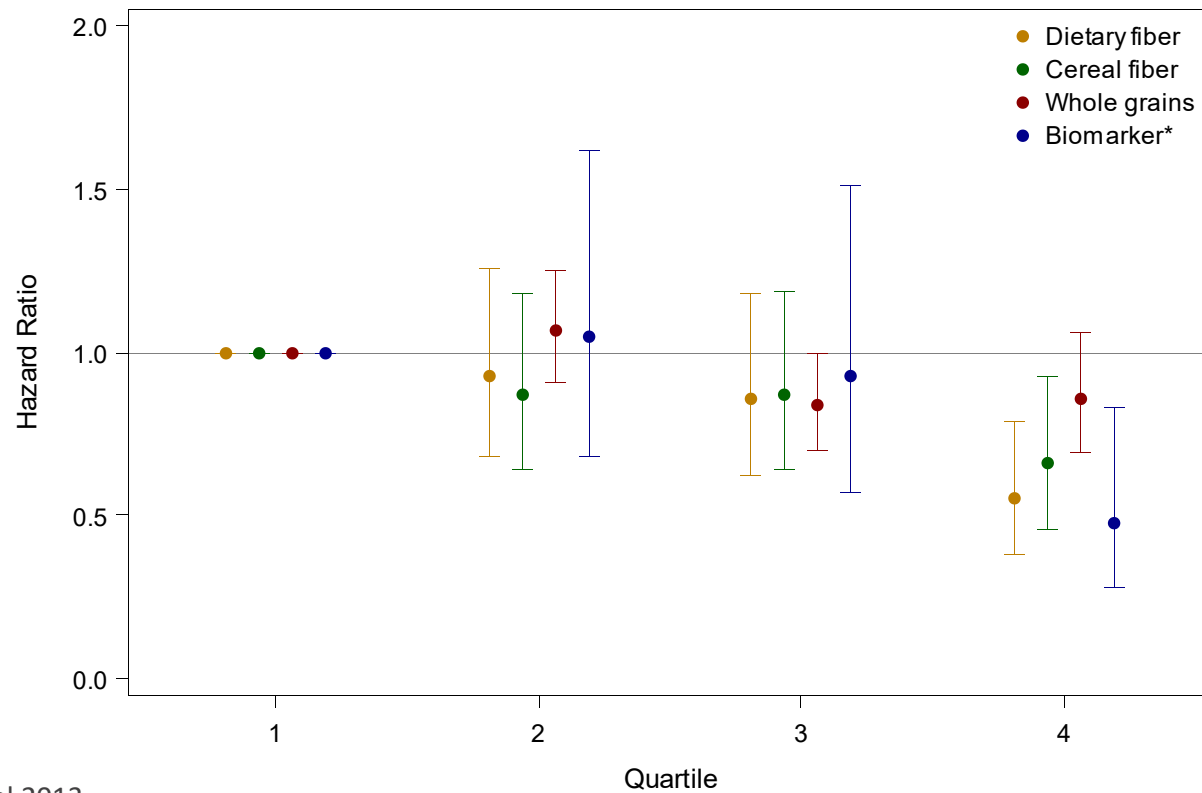


Hansen L *et al.* Int J Cancer 2012
Kyrø C *et al.* Cancer Causes Control 2013



Studies on colorectal cancer

Men

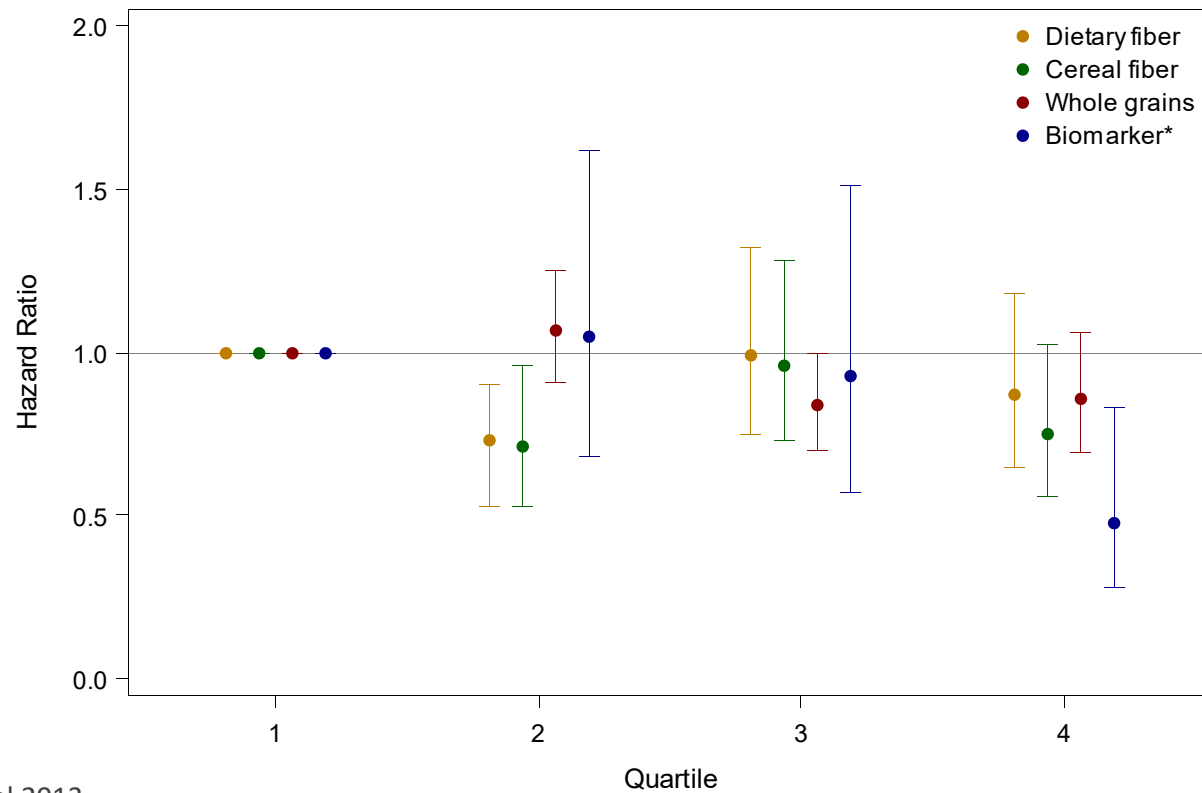


Hansen L *et al.* Int J Cancer 2012
Kyrø C *et al.* Cancer Causes Control 2013
Kyrø C *et al.* J Natl Cancer Inst 2014



Studies on colorectal cancer

Women

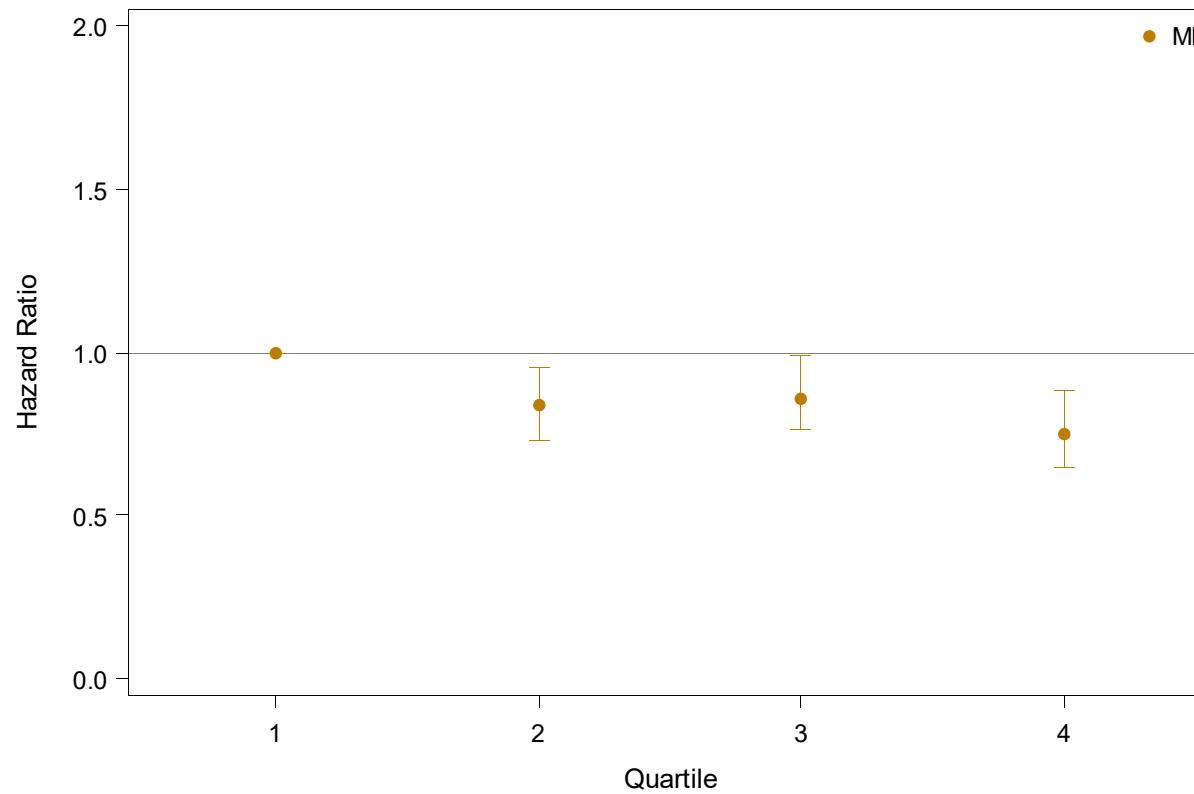


Hansen L *et al.* Int J Cancer 2012
Kyrø C *et al.* Cancer Causes Control 2013
Kyrø C *et al.* J Natl Cancer Inst 2014



Studies on other diseases

Men

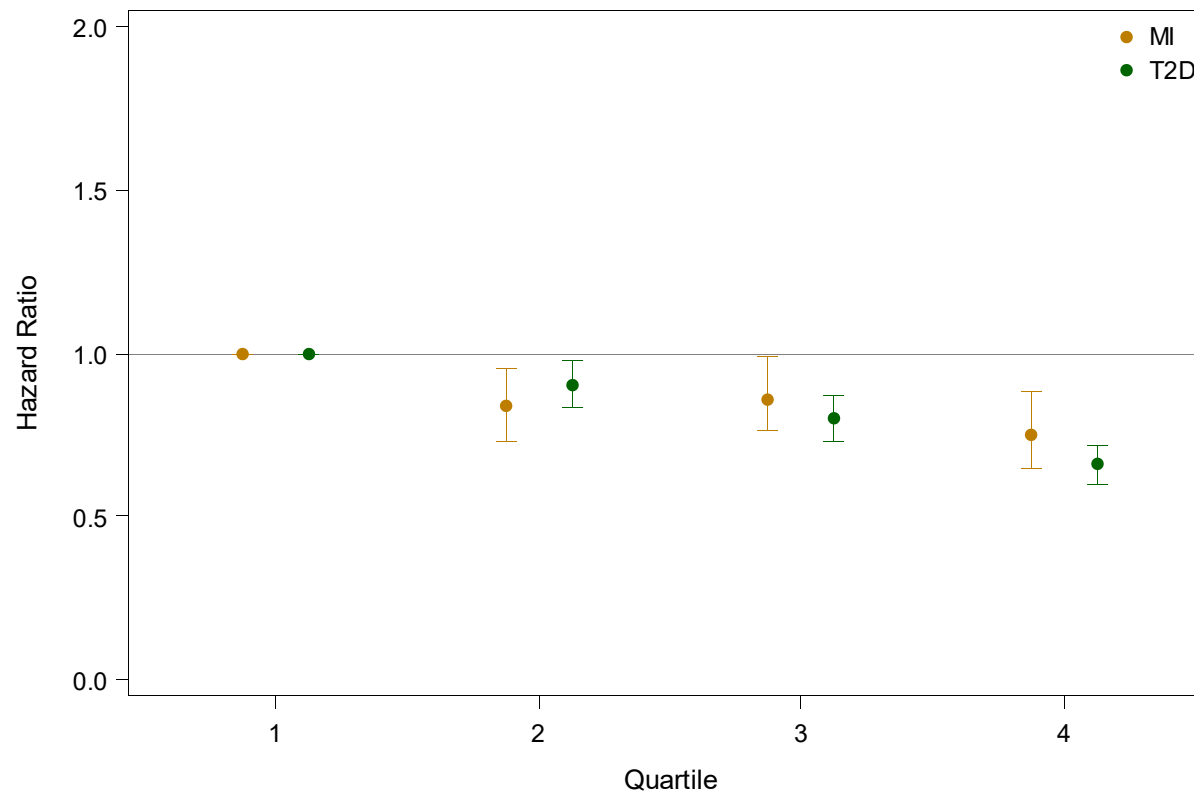
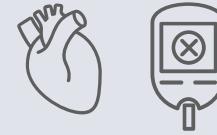


Helnæs AK *et al.* *American Journal of Clinical Nutrition* 2016



Studies on other diseases

Men

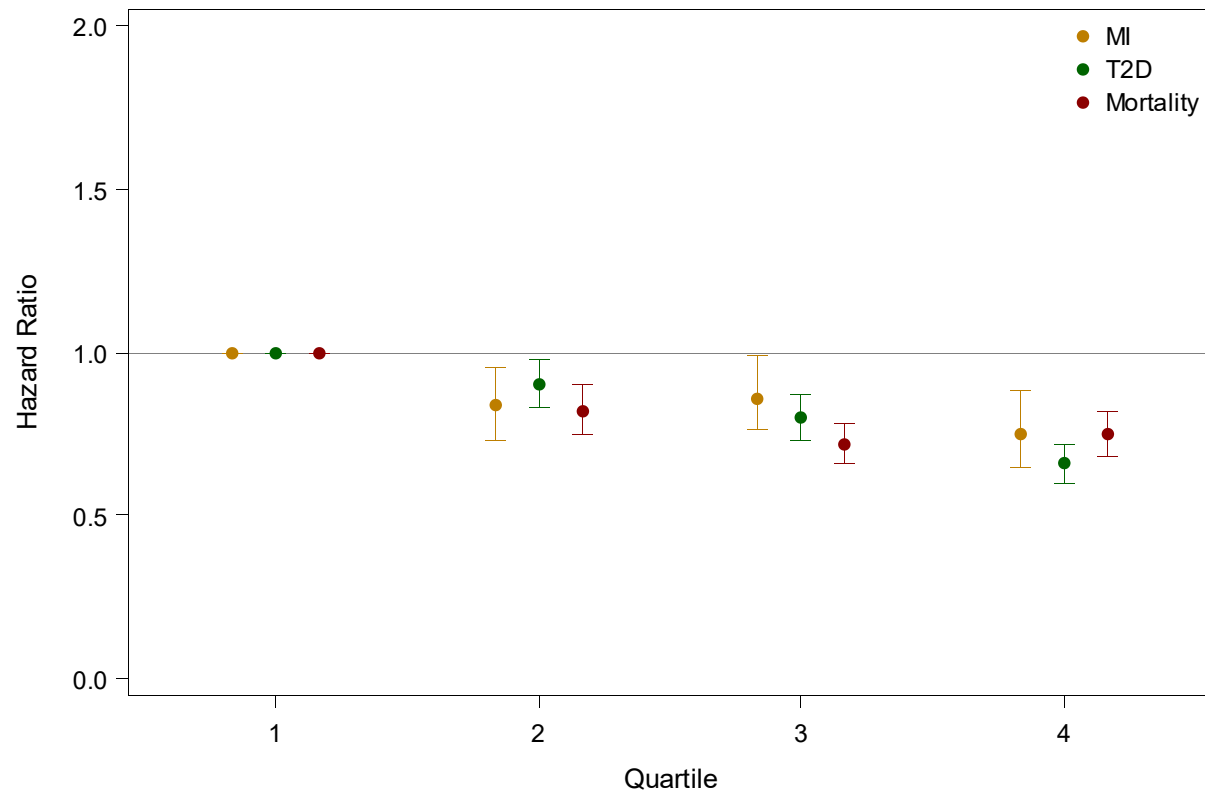


Helnæs AK *et al.* *American Journal of Clinical Nutrition* 2016
Kyrø C *et al.* *Journal of Nutrition* 2018



Studies on other diseases

Men



Johnsen NF *et al.* Br J Nutr 2015

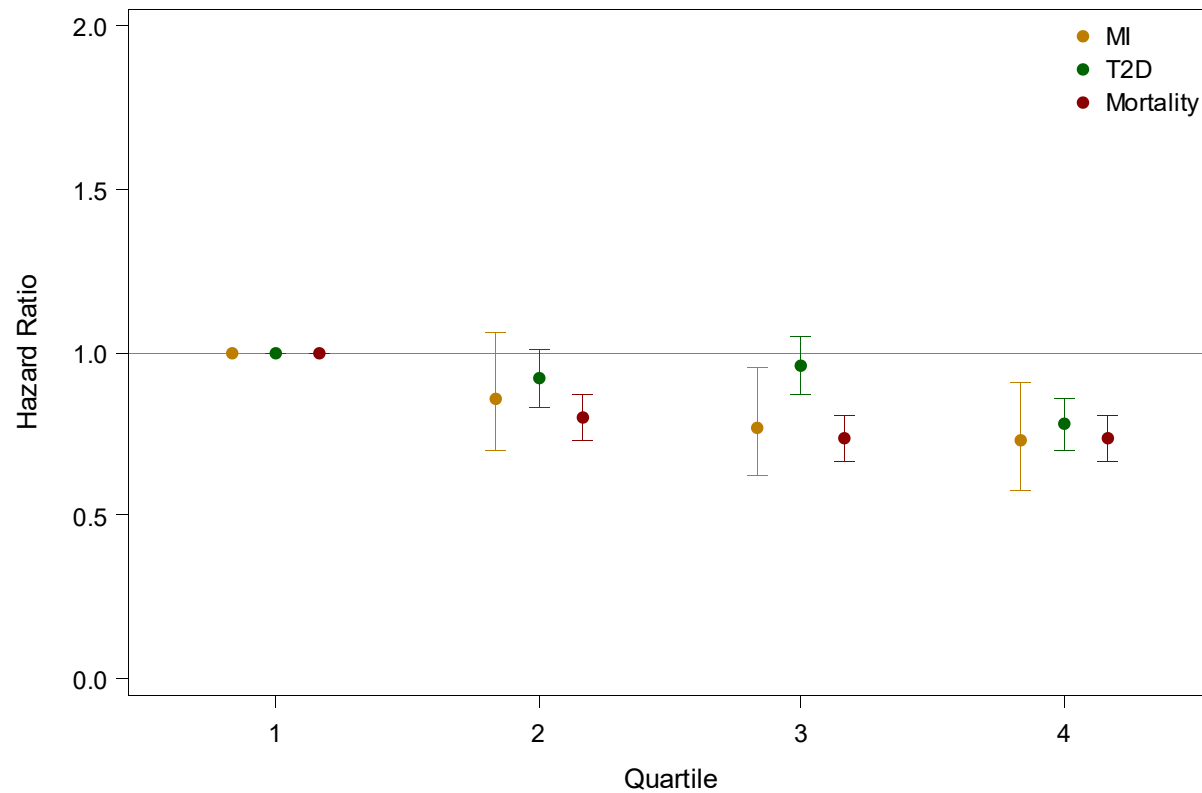
Helnæs AK *et al.* American Journal of Clinical Nutrition 2016

Kyrø C *et al.* Journal of Nutrition 2018



Studies on other diseases

Women



Johnsen NF *et al.* Br J Nutr 2015

Helnæs AK *et al.* American Journal of Clinical Nutrition 2016

Kyrø C *et al.* Journal of Nutrition 2018



Studies on other diseases

Women and men

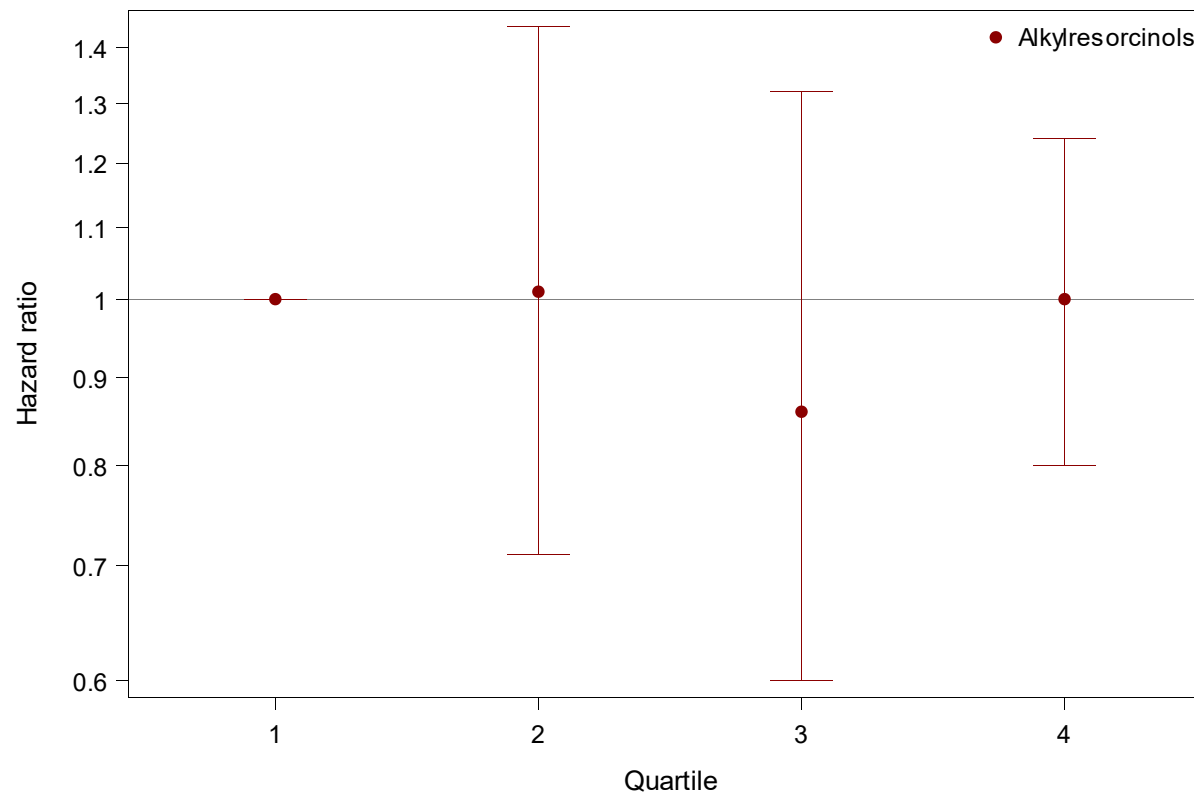


Estimated ORs for T2D according to plasma total AR concentrations (in nmol/L) in sex-specific quartiles or per 25 nmol/L among T2D cases and matched controls in a nested case-control study¹

	Quartile of plasma total AR concentrations				Continuous, per 25 nmol/L
	Q1 (referent)	Q2	Q3	Q4	
Range/increment					
Women	0–19	>19–32	>32–58	>58	
Men	0–23	>23–41	>41–70	>70	
All subjects					
Cases/control subjects, <i>n</i>	186/234	222/232	238/233	285/232	931/931
Model 1	1	1.22 (0.93, 1.60)	1.32 (1.01, 1.72)	1.61 (1.23, 2.12)	1.05 (1.01, 1.09)
Model 2	1	0.91 (0.66, 1.27)	0.99 (0.72, 1.37)	1.25 (0.90, 1.74)	1.04 (1.00, 1.08)
Model 3	1	0.92 (0.66, 1.28)	1.02 (0.74, 1.42)	1.34 (0.95, 1.88)	1.04 (1.00, 1.09)

Breast cancer

Biomarker (alkylresorcinols) measured in adipose tissue



Whole-grain **rye**



Questionnaire data

- Colorectal cancer (1100 cases)
- Myocardial infarction (2300 cases)
- Diabetes (7000 cases)
- Mortality (7800 deceased)

Biomarkers

– Alkylresorcinol C17:0/C21:0 ratio

- **Plasma from EPIC cohort:**
1372 colorectal cases and 1372 matched controls (nested case-control design)
- **Adipose tissue from DCH cohort:**
414 breast cancer cases, 933 sub-cohort (case-cohort design)

Alkylresorcinol C 17:0/C21:0 ratio (higher ratio – higher rye proportion)

Colorectal cancer

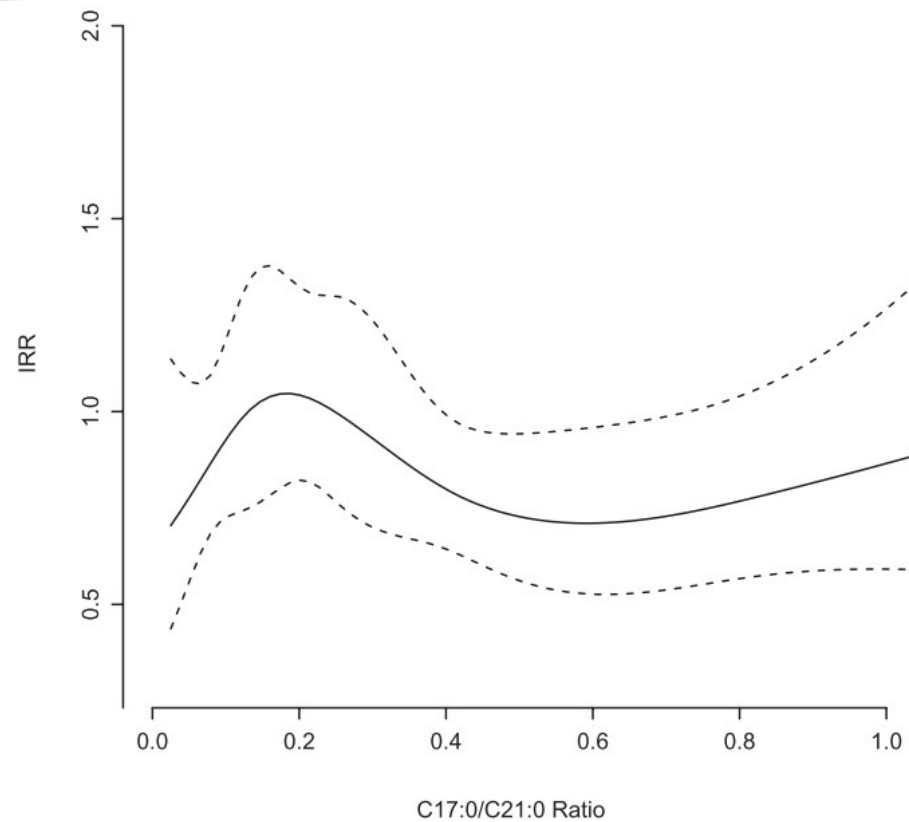


Figure 2. Association between the ratio of the two alkylresorcinol homologs C17:0 and C21:0 and distal colon cancer. Model adjusted for plasma total alkylresorcinol concentration and conditioned on matching factors. In human plasma alkylresorcinol, the C17:0/C21:0 ratio is typically 0.1 to 0.2 when the diet is dominated by whole-grain wheat and 0.6 to 0.8 when the diet is dominated by whole-grain rye. IRR = incidence rate ratio.



Rye

FFQ and biomarker



Disease outcome	Exposure	Increment	RR	RR, men	RR, women	Reference
Colorectal cancer	Rye, FFQ	10 g/day	0.98 (0.94; 1.02)			Kyrø et al, 2013
Myocardial infarction	Rye, FFQ	10 g/day		0.96 (0.93; 0.99)	0.96 (0.90; 1.01)	Heltnæs et al, 2016
Type 2 diabetes	Rye, FFQ	Per serving (16 g/day)		0.92 (0.89; 0.95)	0.99 (0.94; 1.03)	Kyrø et al, 2018
Type 2 diabetes	Alkylresorcinol C17:0/C21:0 ratio	Per SD	0.78 (0.69; 0.88)			Biskup, 2016
Mortality	Rye, FFQ	Per doubling		0.93 (0.91; 0.96)	0.95 (0.92; 0.98)	Johnsen et al, 2015
Breast cancer	Alkylresorcinol C17:0/C21:0 ratio	Per 0.1			1.09 (1.04; 1.14)	Wu et al, 2019



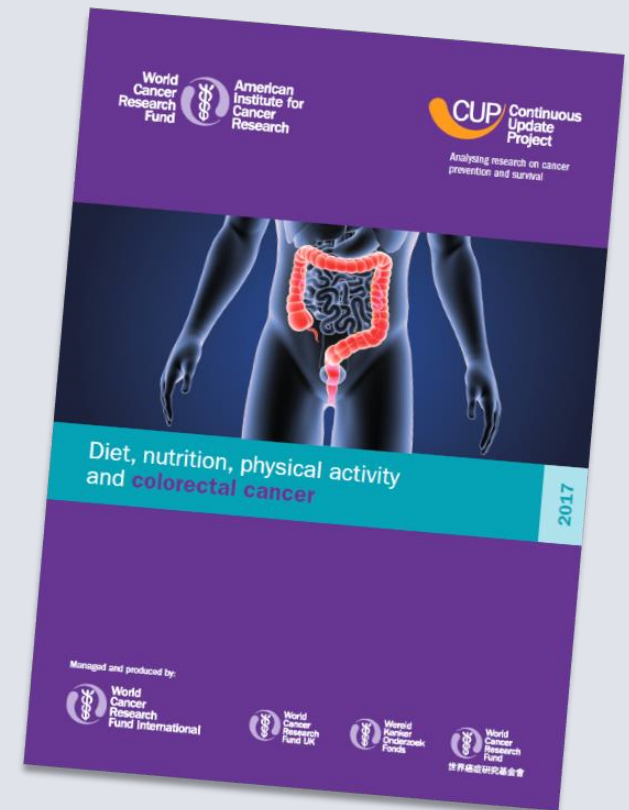
Public health impact



2017 update of evidence

Evidence – Diet, nutrition, physical activity and colorectal cancer

2017	DIET, NUTRITION, PHYSICAL ACTIVITY AND COLORECTAL CANCER 2017		
		DECREASES RISK	INCREASES RISK
STRONG EVIDENCE	Convincing	Physical activity ^{1,2}	Processed meat ³ Alcoholic drinks ⁴ Body fatness ⁵ Adult attained height ⁶
	Probable	Wholegrains ¹ Foods containing dietary fibre ⁷ Dairy products ⁸ Calcium supplements ⁹	Red meat ¹⁰



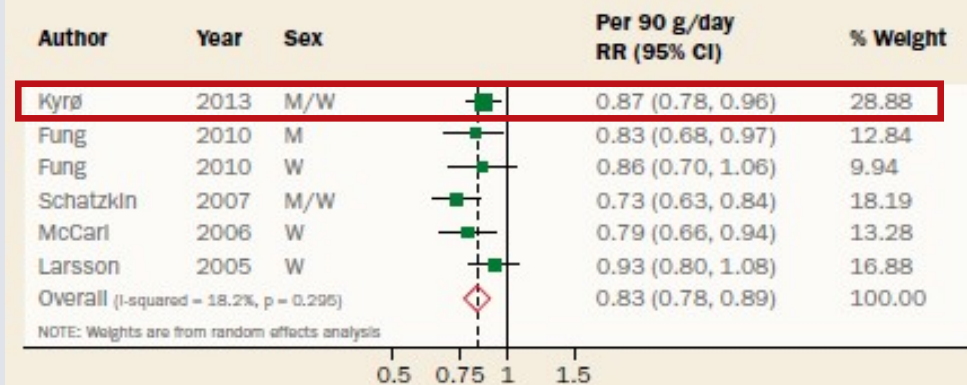
World Cancer Research Fund / American Institute for Cancer Research. Continuous Update Project Report. Food, Nutrition, Physical Activity, and the Prevention of Colorectal Cancer. 2017



2017 update of evidence

Evidence – Diet, nutrition, physical activity and colorectal cancer

Figure 1: Dose-response meta-analysis of wholegrains intake and colorectal cancer per 90 grams per day



The Danish Whole Grain Partnership

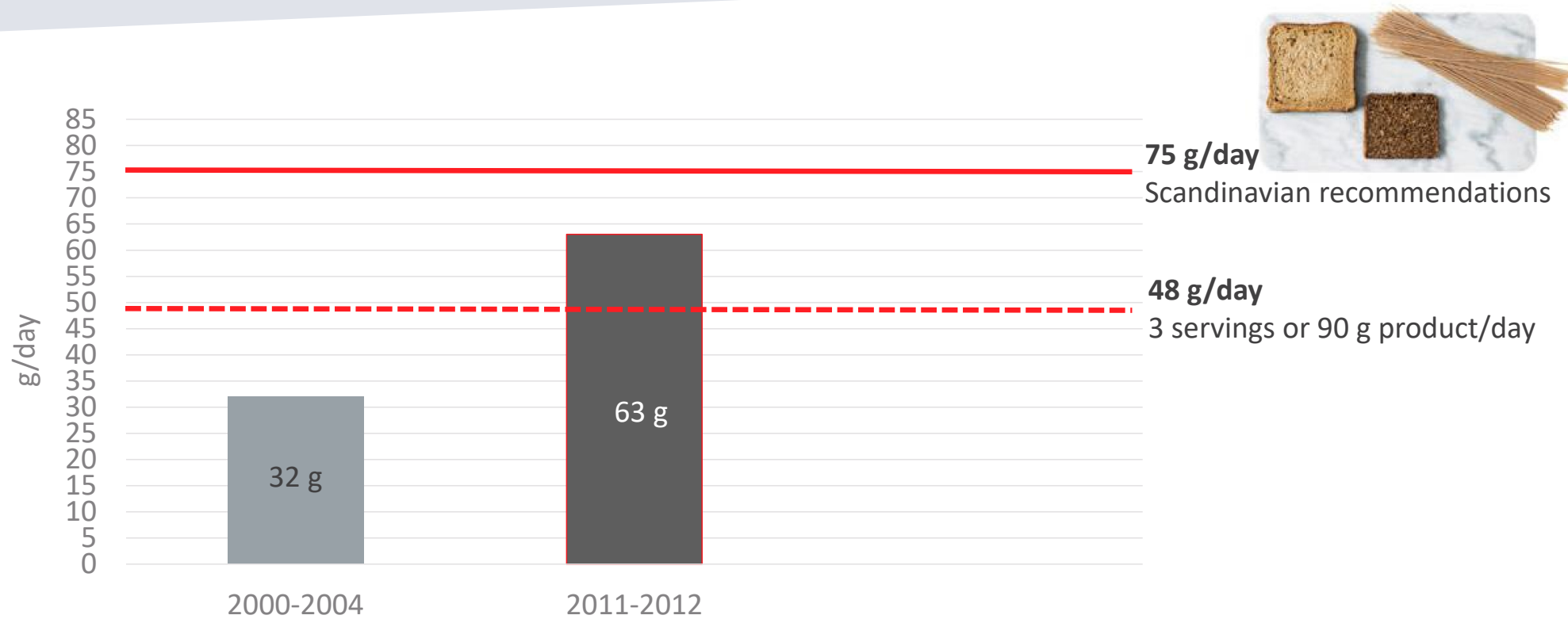
- a public-private partnership



<https://fuldkorn.dk/english/>

The Danish Whole Grain Partnership

- *Whole-grain intake*



Results from a
fruitfull collaboration
and a public health
success

THANK YOU!



NordForsk



Innovation Fund Denmark

RESEARCH, TECHNOLOGY & GROWTH