

EGEA VIII CONFÉRENCE
NUTRITION ET SANTÉ
DE LA SCIENCE À LA PRATIQUE

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Fruits and vegetables and prevention of
cancer and premature mortality

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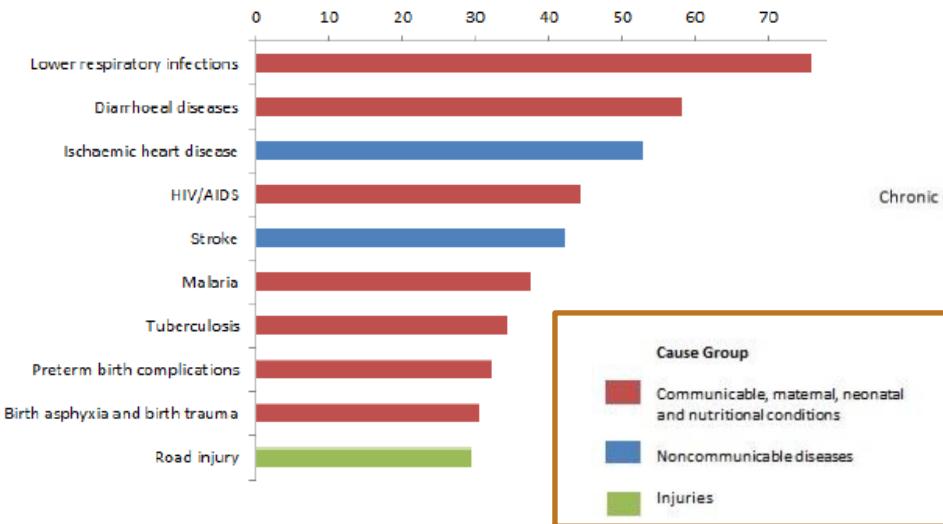
Outline

1. World Cancer Research Fund update of the scientific evidence on diet, nutrition, physical activity and cancer
2. Preventability of cancer and premature death in people with high intake of fruits and vegetables

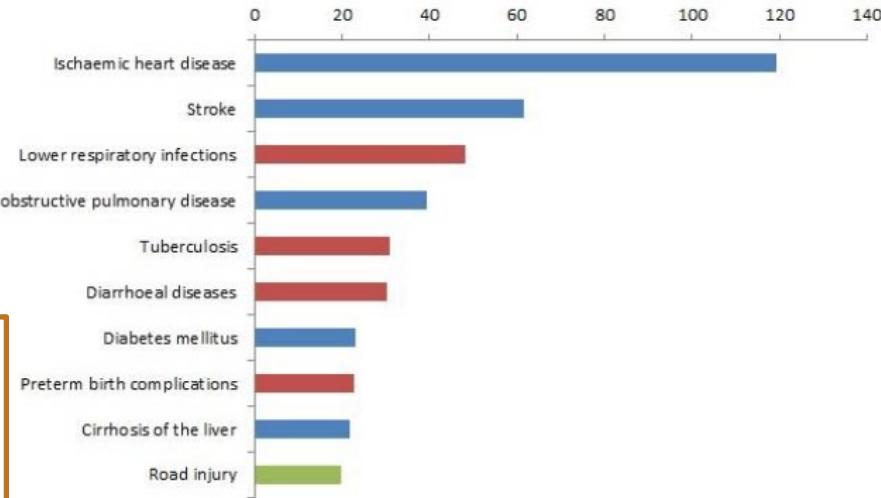
Top 10 causes of death by country income level, 2016

Crude death rate (per 100 000 population)

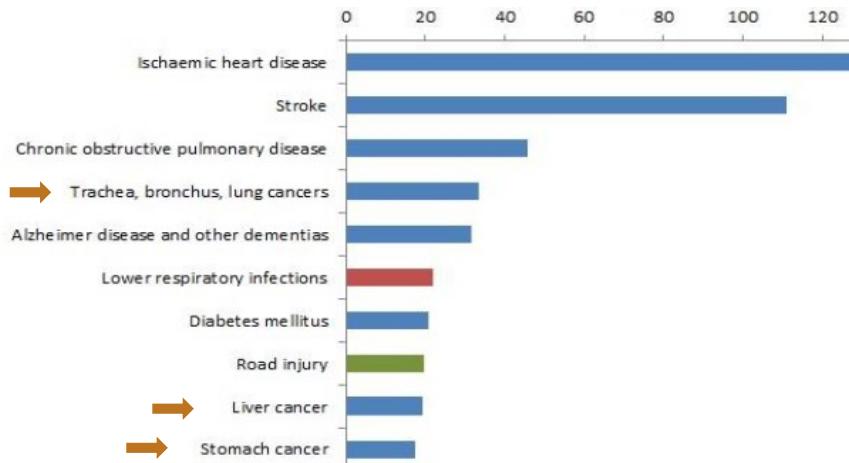
Lower income



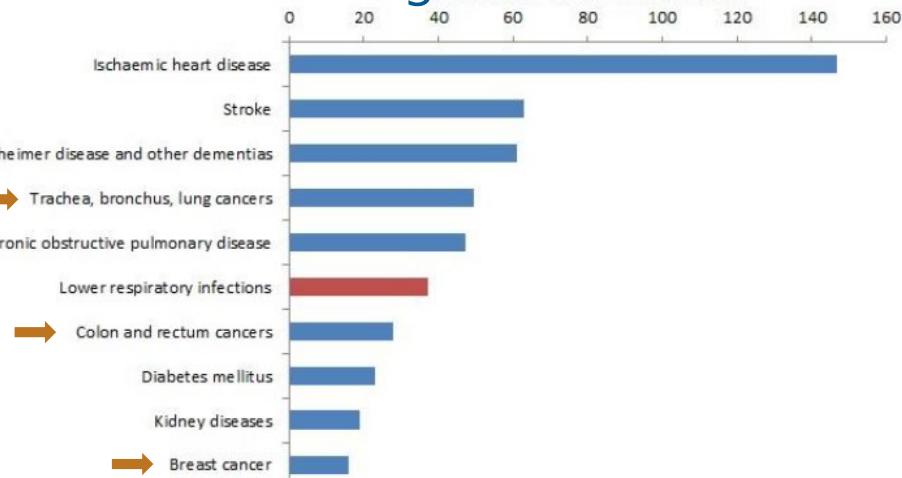
Lower-middle-income



Upper-middle-income

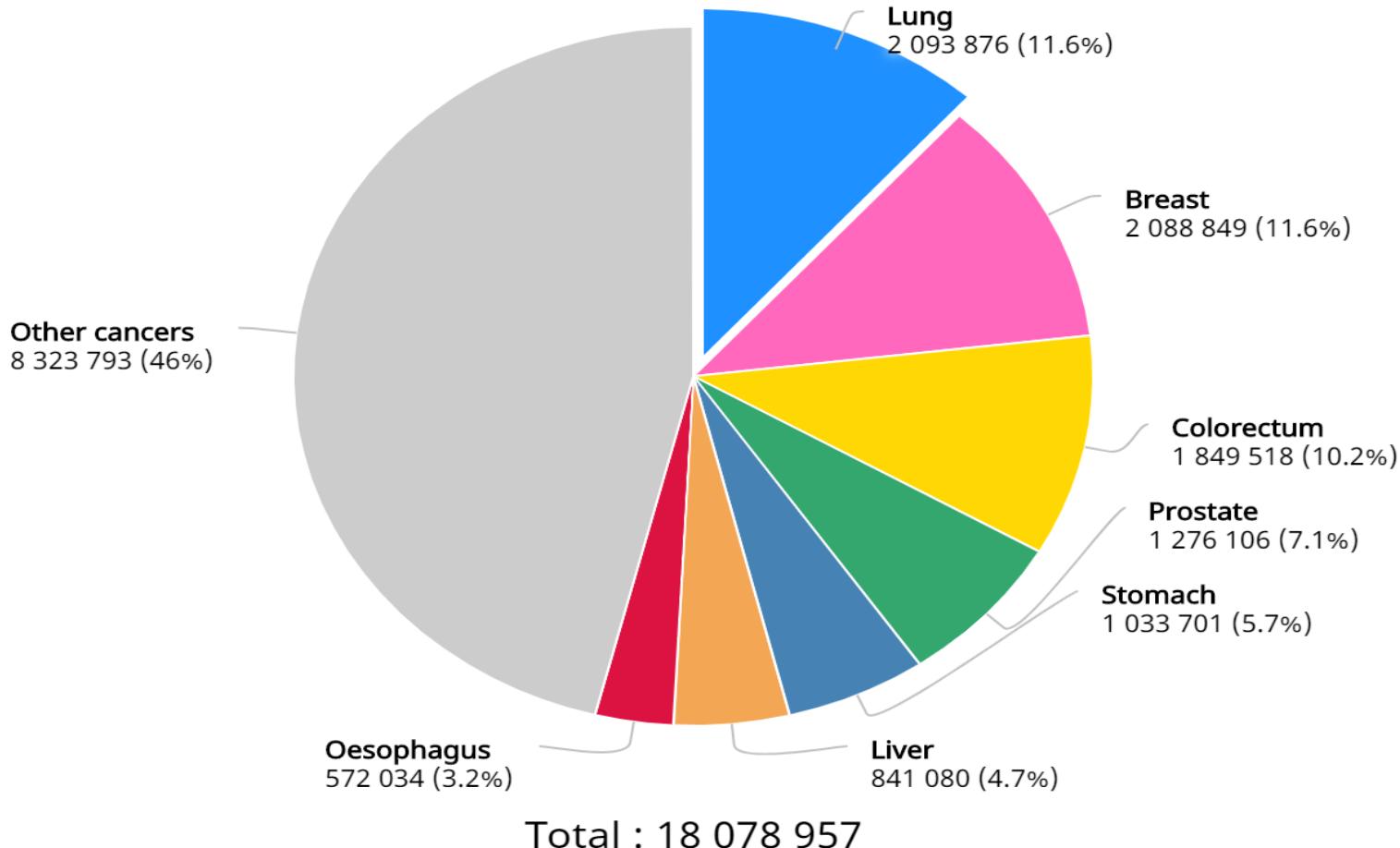


Higher-income



Cancer. A worldwide epidemic

Estimated number of new cases per year



Source: GLOBOCAN, 2018

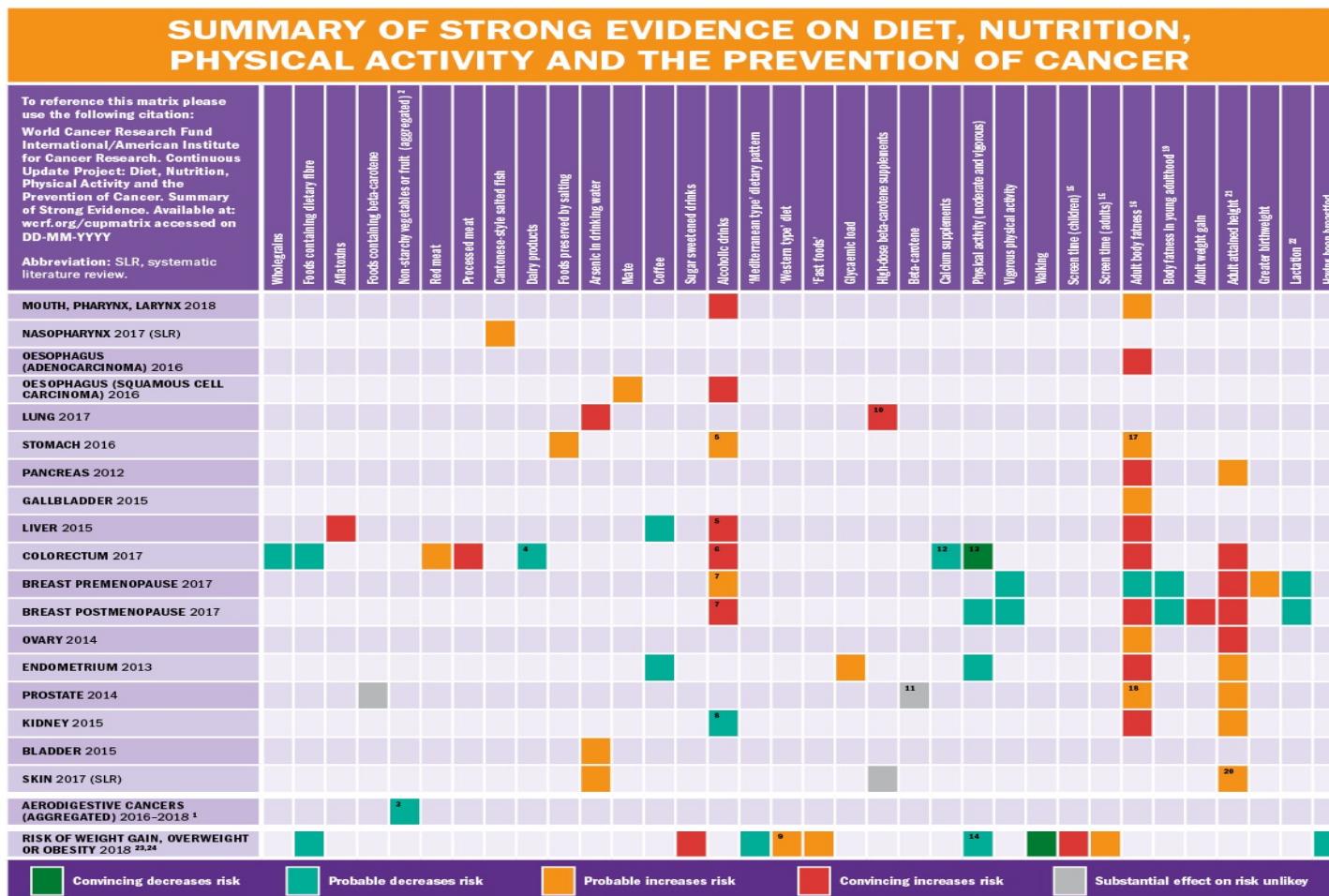


Diet, Nutrition, Physical Activity and Cancer: a Global Perspective

- 2018: Third expert report
- Data from 9,991 publications investigating risk of 17 different cancers



Findings – Strong evidence for recommendations



© World Cancer Research Fund International dietandcancerreport.org





RECOMMENDATION

Eat a diet rich in wholegrains, vegetables, fruit and beans

Make wholegrains, vegetables, fruit, and pulses (legumes) such as beans and lentils a major part of your usual daily diet

- GOAL** Consume a diet that provides at least 30 grams per day of fibre¹ from food sources
- GOAL** Include in most meals foods containing wholegrains, non-starchy vegetables, fruit and pulses (legumes) such as beans and lentils
- GOAL** Eat a diet high in all types of plant foods including at least five portions or servings (at least 400 grams or 15 ounces in total) of a variety of non-starchy vegetables and fruit every day
- GOAL** If you eat starchy roots and tubers as staple foods, eat non-starchy vegetables, fruit and pulses (legumes) regularly too if possible

¹ Measured by the AOAC method.

Evidence of protection graded “suggestive”

Fruits, vegetables	Oesophagus Lung (people who smoke or used to smoke) Bladder
Vegetables	Breast (oestrogen receptor negative) Mouth pharynx and larynx Nasopharynx
Citrus fruits	Stomach (cardia)
Foods containing carotenoids	Lung Breast
Foods containing vitamin C	Lung (people who smoke or used to smoke) Colon

Evidence of risk increase graded “suggestive”

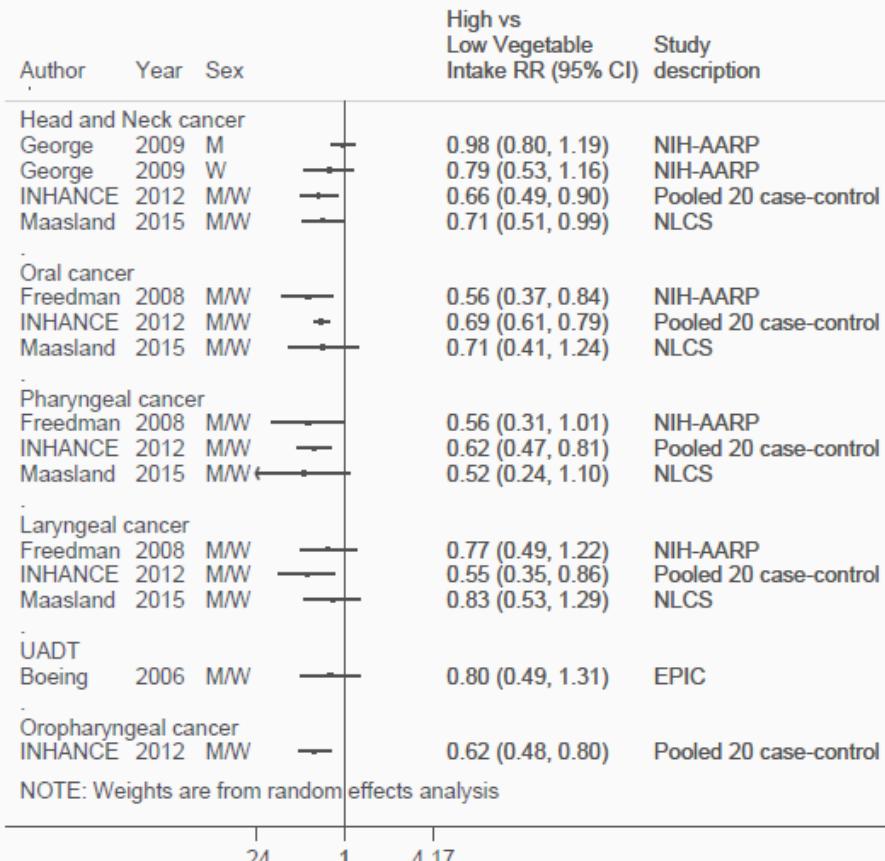
Low consumption of fruits and vegetables	Colorectal
Low consumption of fruits	Stomach

Data synthesis behind the cancer recommendations

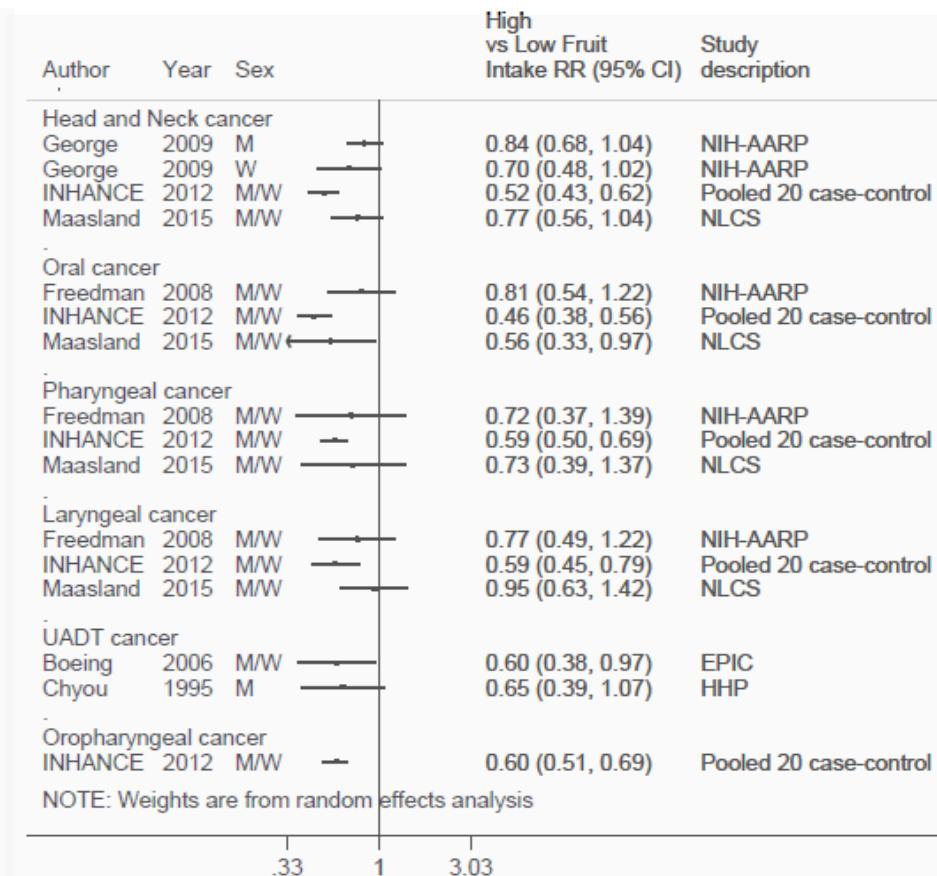
**Continuous Update Project
Imperial College London**

Mouth, pharynx and larynx (suggestive evidence)

Vegetables



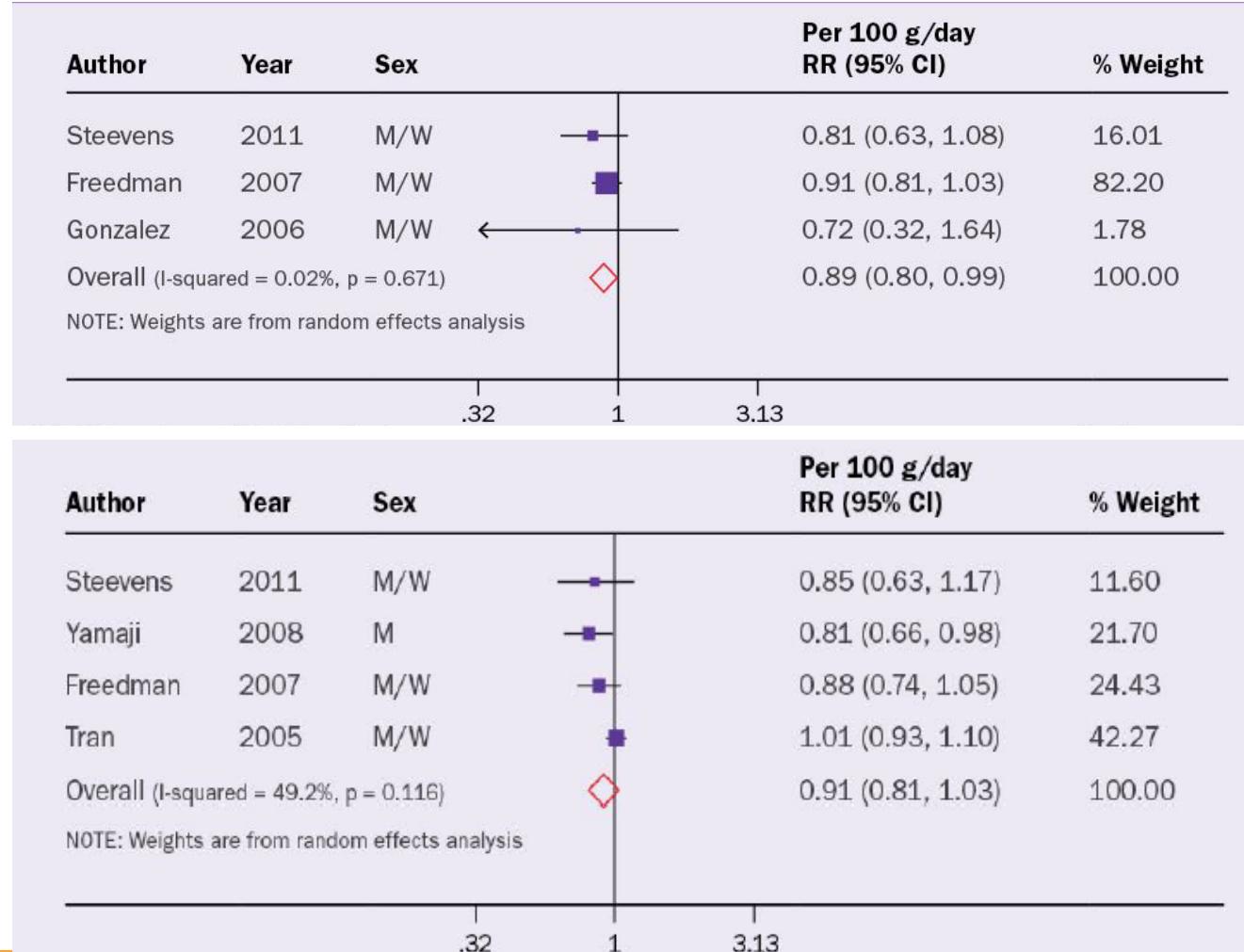
Fruits



Oesophageal cancer and fruits intake (suggestive evidence)

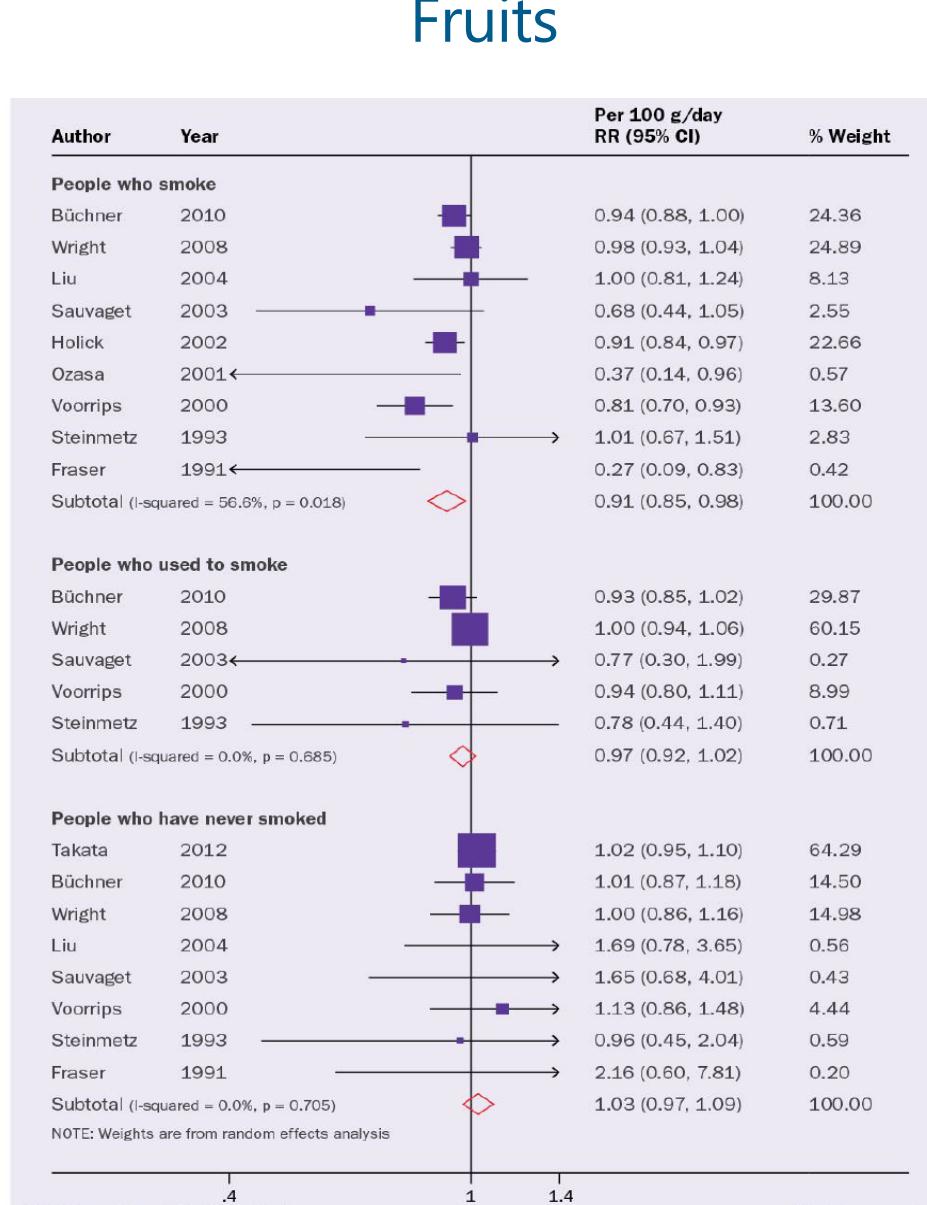
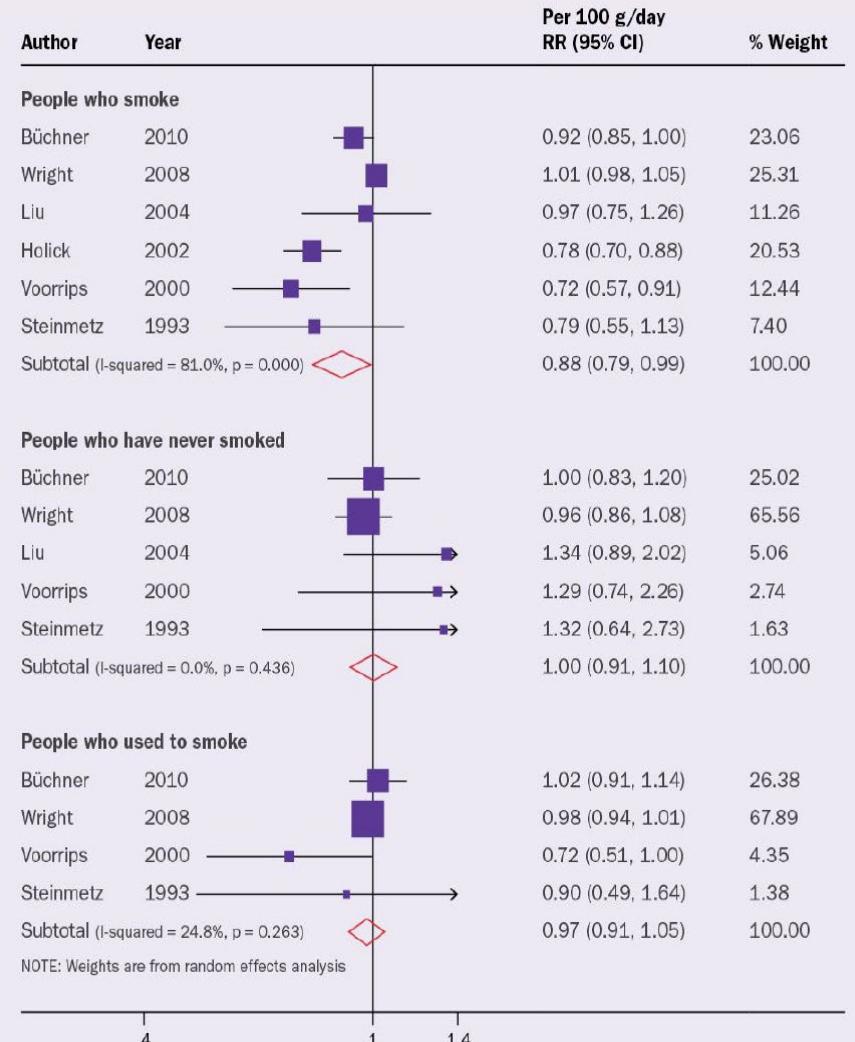
Adeno-
carcinoma

Squamous
cell
carcinoma

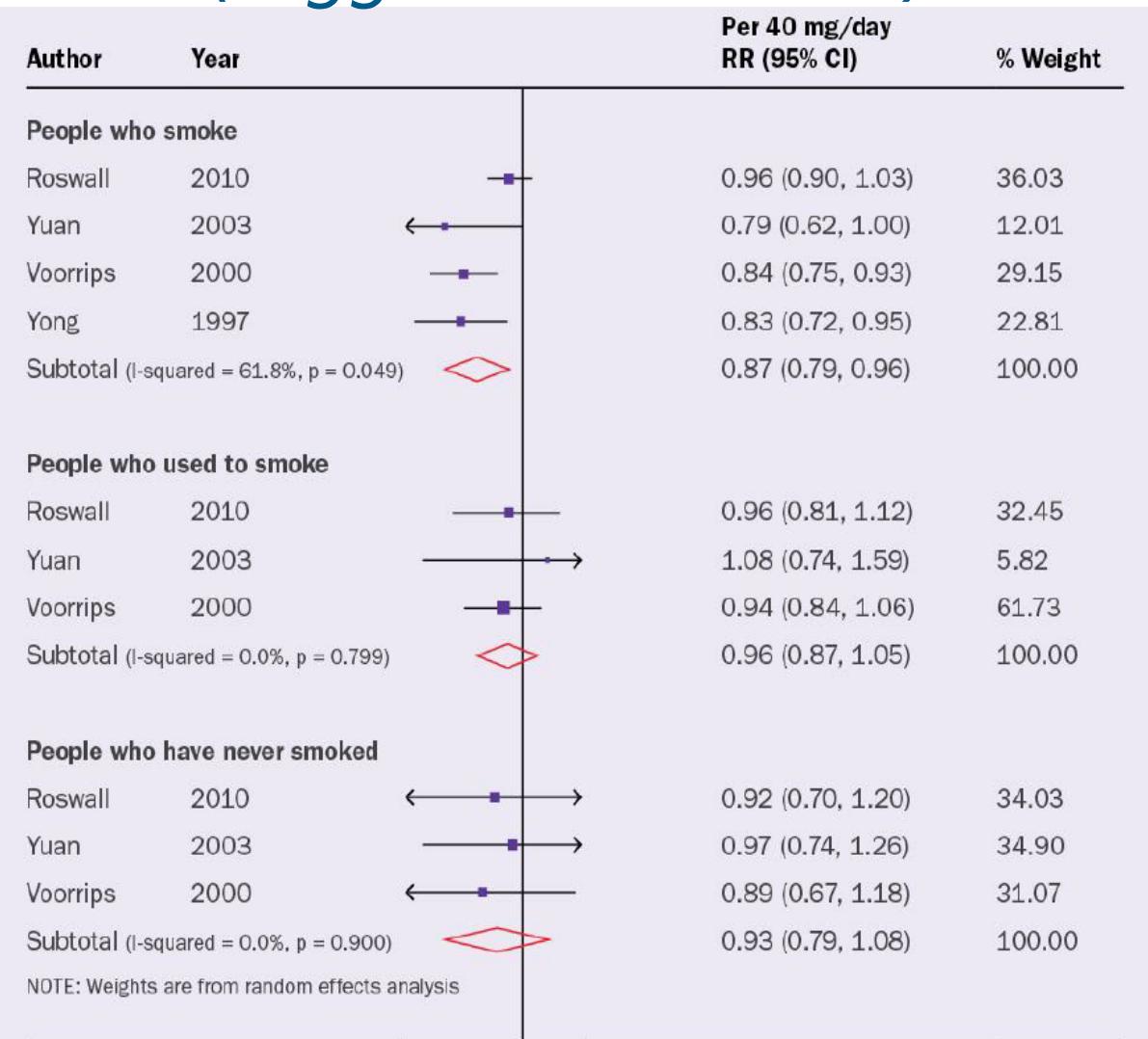


Lung cancer, fruits and vegetables intake (suggestive evidence)

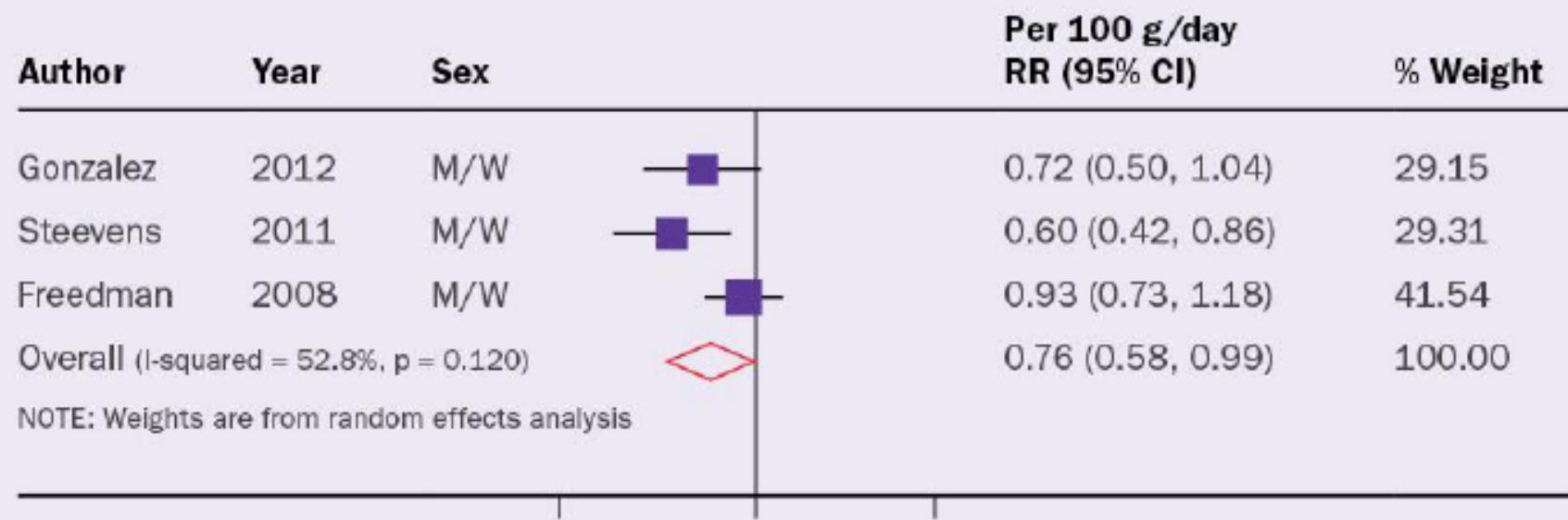
Vegetables



Lung cancer and dietary vitamin C (suggestive evidence)



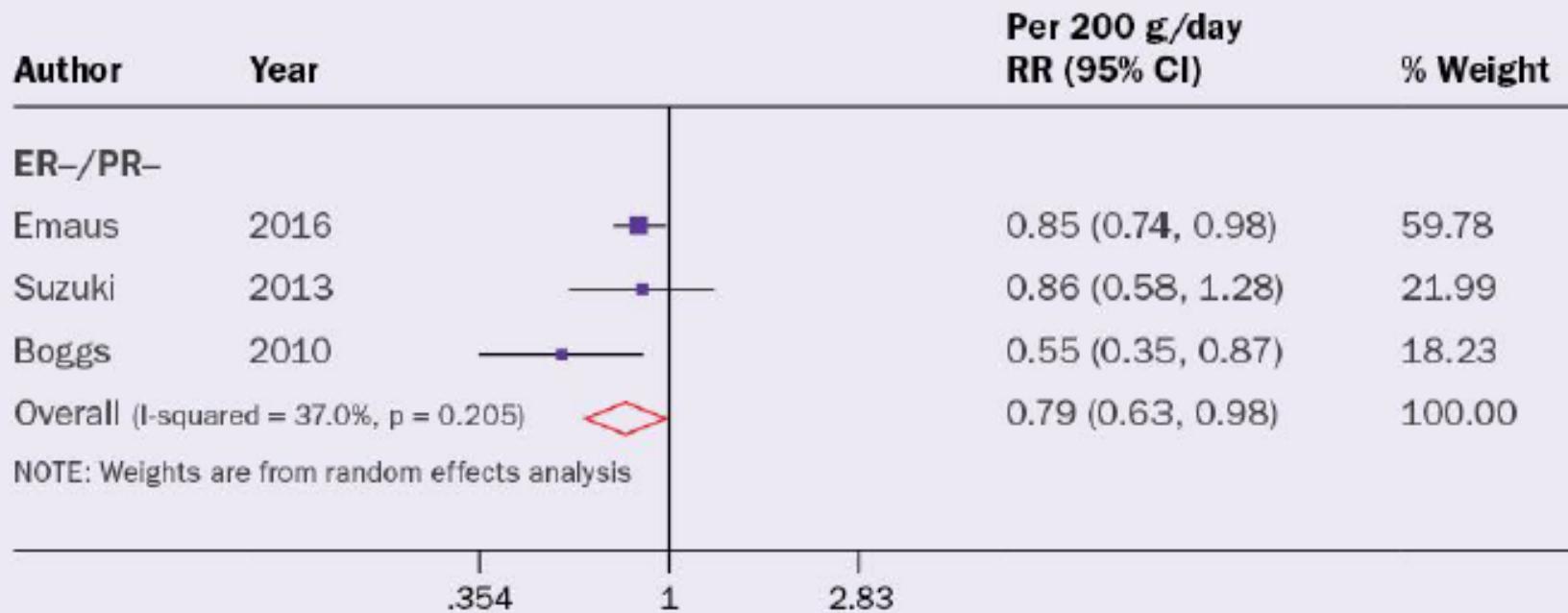
Cardia stomach cancer and citrus fruits intake (suggestive evidence)



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Oestrogen/progesterone receptor breast cancer and vegetables intake (suggestive evidence)



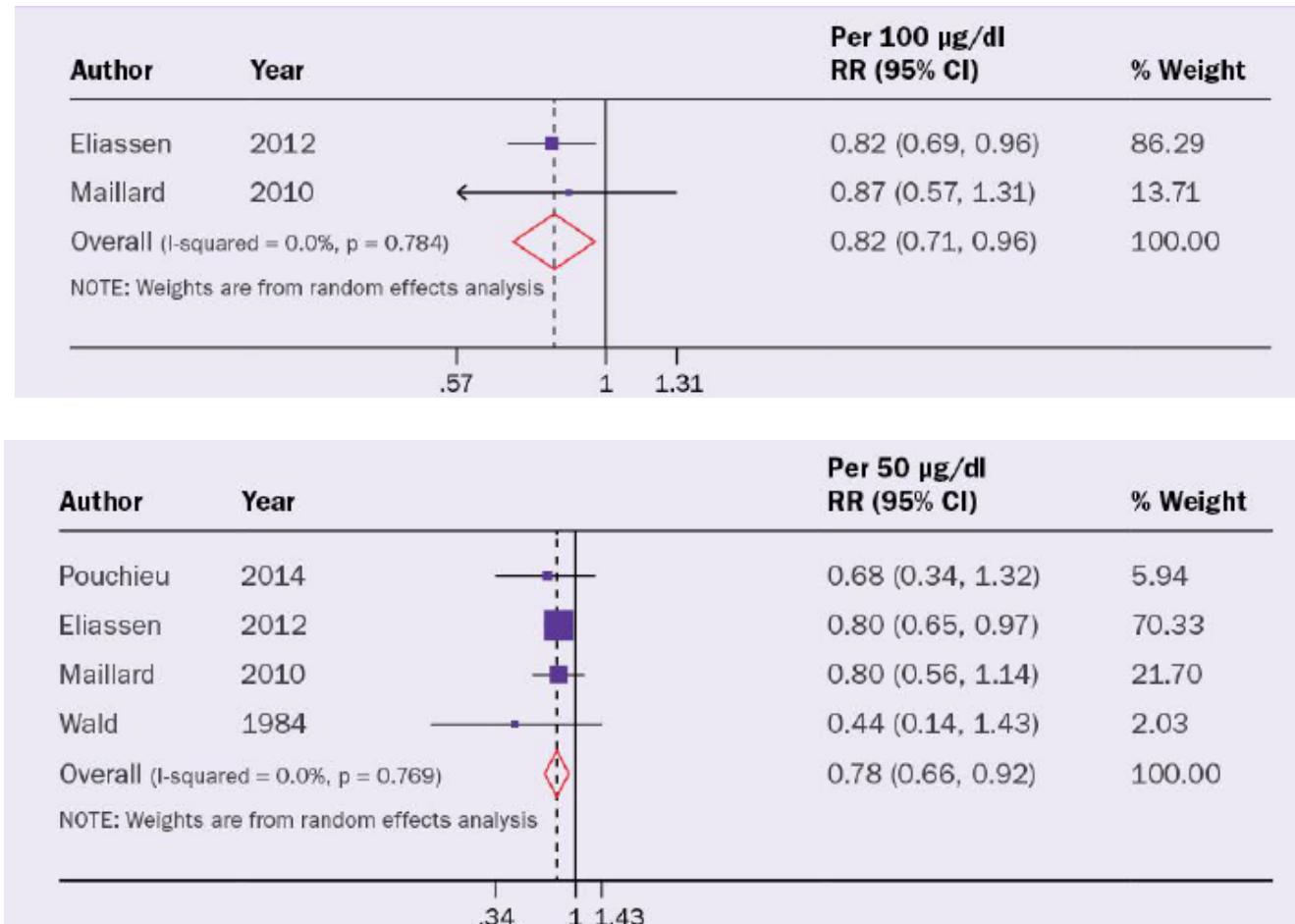
© World Cancer Research Fund International

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Breast cancer and plasma serum carotenoids

Plasma/serum
carotenoids

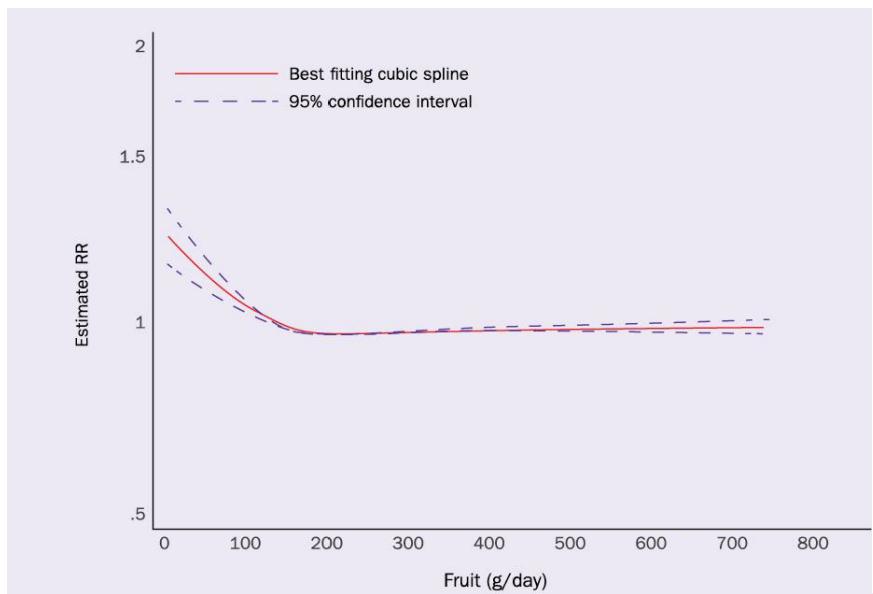
Plasma/serum
beta-carotenes



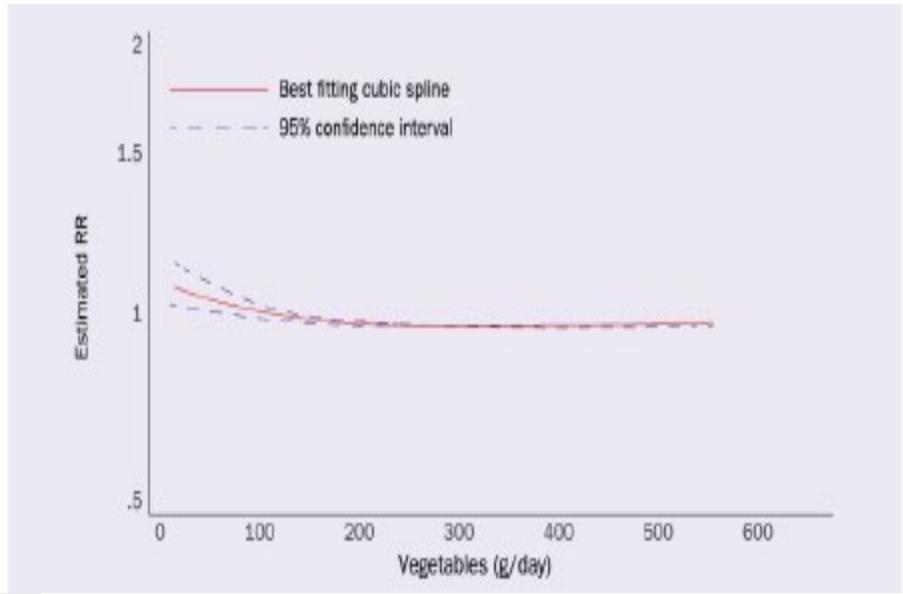
Colorectal cancer , low fruits and vegetables intake

(suggestive evidence)

Fruits



Vegetables

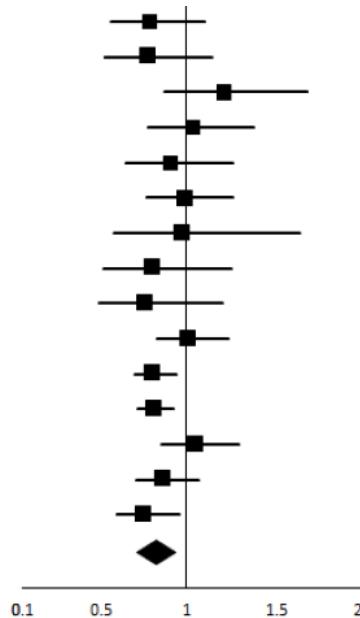


Other evidence supporting the health benefits of fruits and vegetables

“Healthy” dietary patterns, breast and colorectal cancer

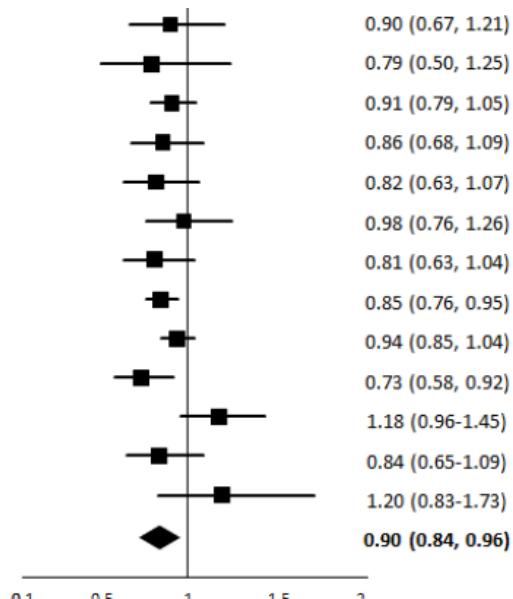
Colorectal cancer

Terry, 2001 F (healthy)
Fung, 2003 F (prudent)
Dixon, 2004 ATBC M (vegetable)
Dixon, 2004 NLCS M (vegetable)
Dixon, 2004 NLCS F (vegetable)
Dixon, 2004 SMC F (vegetable)
Kim, 2005 F (healthy)
Kim, 2005 M (healthy)
Kesse, 2006 F (healthy)
Butler, 2008 (vegetable)
Flood, 2008 M (fruit and vegetable)
Flood, 2008 M (light)
Flood, 2008 F (fruit and vegetable)
Flood, 2008 F (light)
Kumagai, 2014 (fruit and vegetable)
TOTAL
 $I^2 = 12\%$



Mannisto, 2005 NLCS (vegetables)
Mannisto, 2005 ORDET (vegetables)
Mannisto, 2005 SMC (vegetables)
Agurs-Collins, 2009 (prudent)
Butler, 2010 (vegetables, fruit, soy)
Baglietto, 2011 (vegetables)
Baglietto, 2011 (fruit and salad)
Link, 2013 (plant-based)
Link, 2013 (ethnic)
Catsburg, 2015 CSDLH (healthy pattern)
Catsburg, 2015 CSDLH (ethnic pattern)
Catsburg, 2015 NBSS (healthy pattern)
Catsburg, 2015 NBSS (ethnic pattern)
TOTAL
 $I^2 = 26\%$

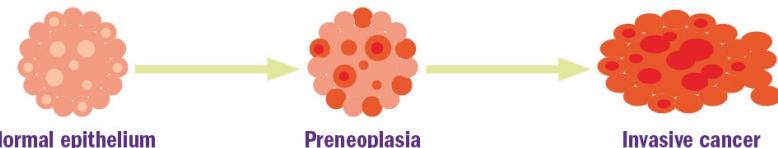
Breast cancer



From: Grosso et al. doi: 10.1093/nutrit/nux012
Nutrition Reviews 2017 Vol. 75(6):405–419

Diet, nutrition, physical activity and the cancer process

Diet, nutrition and physical activity, other environmental exposures and host factors interact to affect the cancer process



Lower fruit and vegetable intake

Folate deficiency

DNA uracil misincorporation

Genome instability

Low dietary fibre intake

Low butyrate

Reduced apoptosis; increased proliferation

Low levels of carotenoids, vitamin A, C, E

Oxidative stress, inflammation

Increased inflammation, genomic instability, reduced apoptosis; increased proliferation

Diet/Lifestyle Factors

Nutrients, Energy intake, Phytochemicals, Other food components, Alcohol, Physical activity, Smoking, Other lifestyle factors

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Potential impact of diet, nutrition, physical activity and height in increasing susceptibility to cancer

Exposure	Systemic impact	Cell function	Hallmarks possibly affected
Greater body fatness	Hyperinsulinemia	mTOR/PI3K/AKT, MAPK	Reduced apoptosis; increased proliferation, genome instability
	Increased oestradiol	MAPK/ERK/PI3K	Increased proliferation in ER+ tissues; genome instability
	Inflammation	STAT3/NF-κB	Reduced apoptosis, increased cell division, altered macrophage function, etc.; genome instability

Greater alcohol intake	Increased oestradiol	MAPK/ERK/PI3K	Increased proliferation in ER+ tissues
	Inflammation	STAT3/NF-κB	Reduced apoptosis, increased cell division, altered macrophage function, etc.
	Folate deficiency; interference with 1-carbon metabolism	DNA uracil misincorporation	Genome instability
Greater physical activity	Reduction in insulin	mTOR/PI3K/AKT, MAPK	Increased apoptosis; reduced proliferation, less genome instability
	Reduction in oestradiol and testosterone	MAPK/ERK/PI3K	Reduced proliferation in ER+ tissues; reduced genome instability
	Reduced inflammation (long term); improved immune function	STAT3/NF-κB	Increased apoptosis, increased cell division, altered macrophage function etc; reduced genome instability
Greater height	E.g. WNT, P53	E.g. cellular energetics, etc.	
Greater height	Higher IGF-I	mTOR/PI3K/AKT, MAPK	Reduced apoptosis; increased proliferation





Original article

Fruit and vegetable intake and the risk of cardiovascular disease, total cancer and all-cause mortality—a systematic review and dose-response meta-analysis of prospective studies

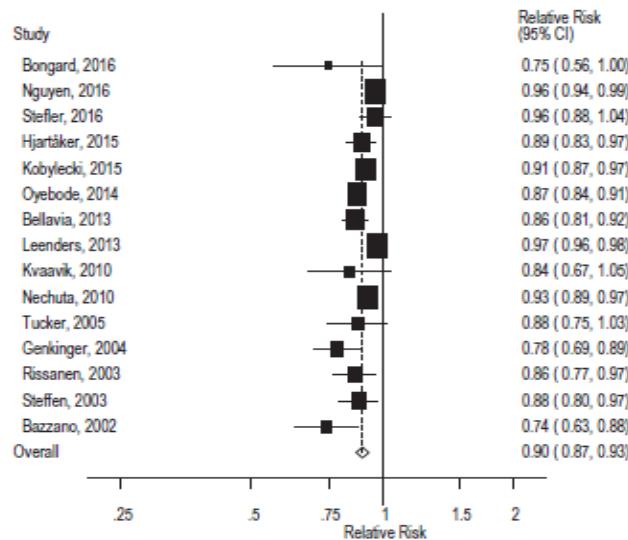
Dagfinn Aune^{1,2,3*}, Edward Giovannucci^{4,5,6}, Paolo Boffetta⁷, Lars T. Fadnes⁸, NaNa Keum^{5,6}, Teresa Norat², Darren C. Greenwood⁹, Elio Riboli², Lars J. Vatten¹ and Serena Tonstad¹⁰

Systematic literature review
95 cohort studies (142 publications)

Fruits and vegetables

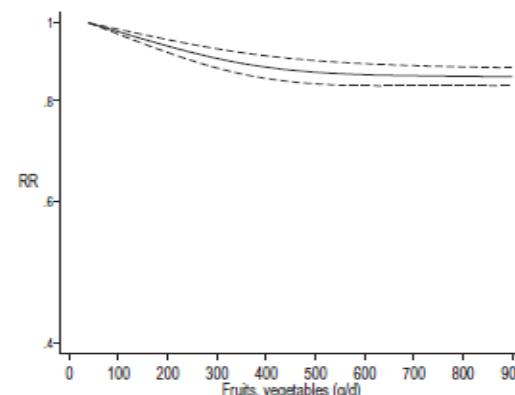
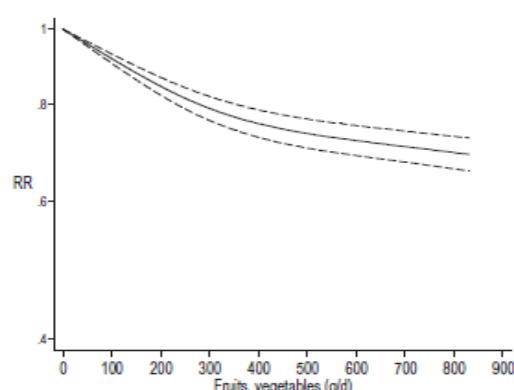
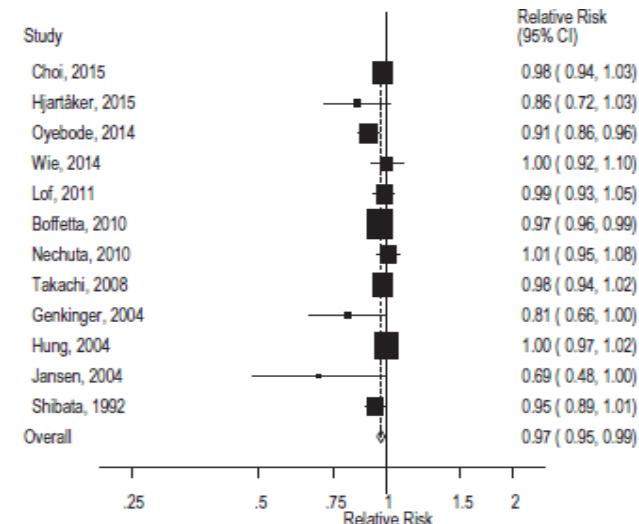
All-cause mortality

15 studies, 71 160 cases, I^2 : 82.5%
RR 200 g/d: 0.90 (0.87-0.93)

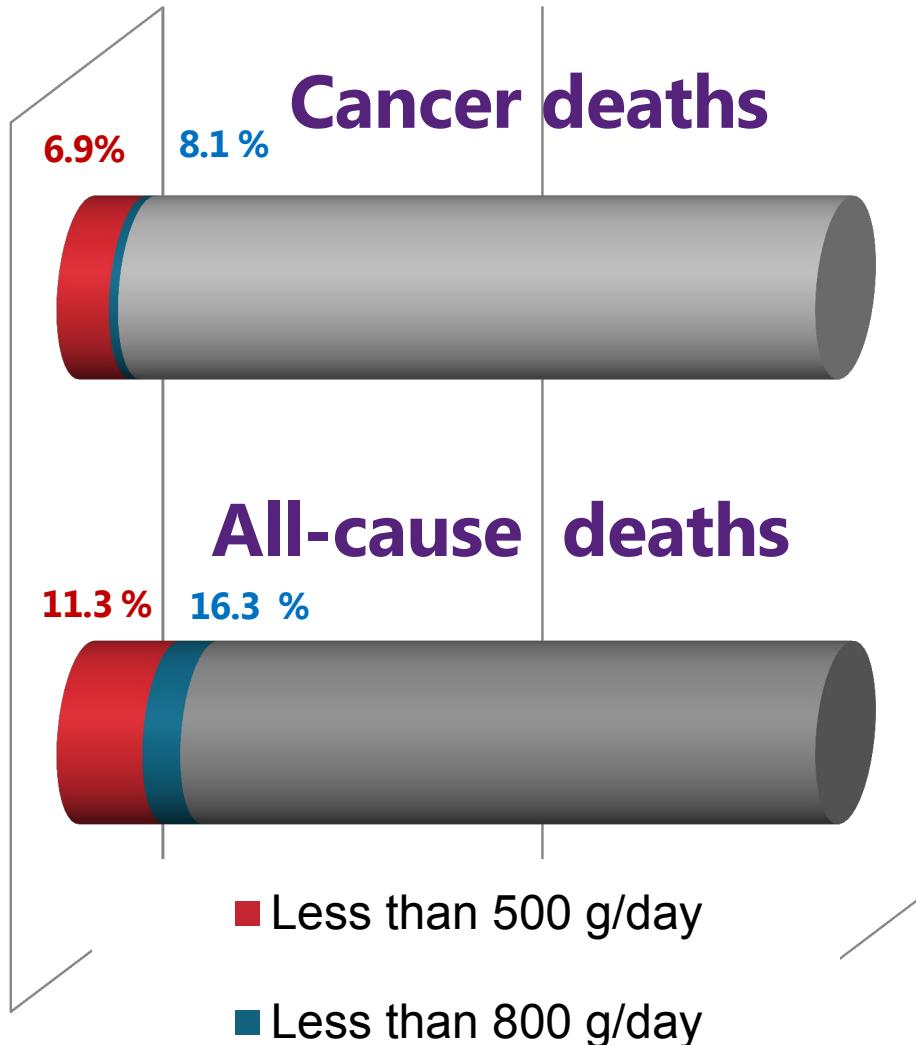


Cancer

12 studies, 52 872 cases, I^2 : 48.7%
RR 200 g/d: 0.97 (0.95-0.99)



Preventability: Fraction of deaths attributable to low fruit and vegetable intake worldwide, 2013



562 056 cancer deaths attributable to fruit and vegetable intake below 500 g/day
657 923 cancer deaths attributable to intake below 800 g/day

5.4 million premature deaths attributable to fruit and vegetable intake below 500 g/day
7.8 million attributable to intake below 800 g/day

Key message: Additive, complementary, and synergistic effects of numerous foods (dietary pattern) do matter in cancer prevention, especially when combined with adequate energy balance (physical activity and weight control).



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