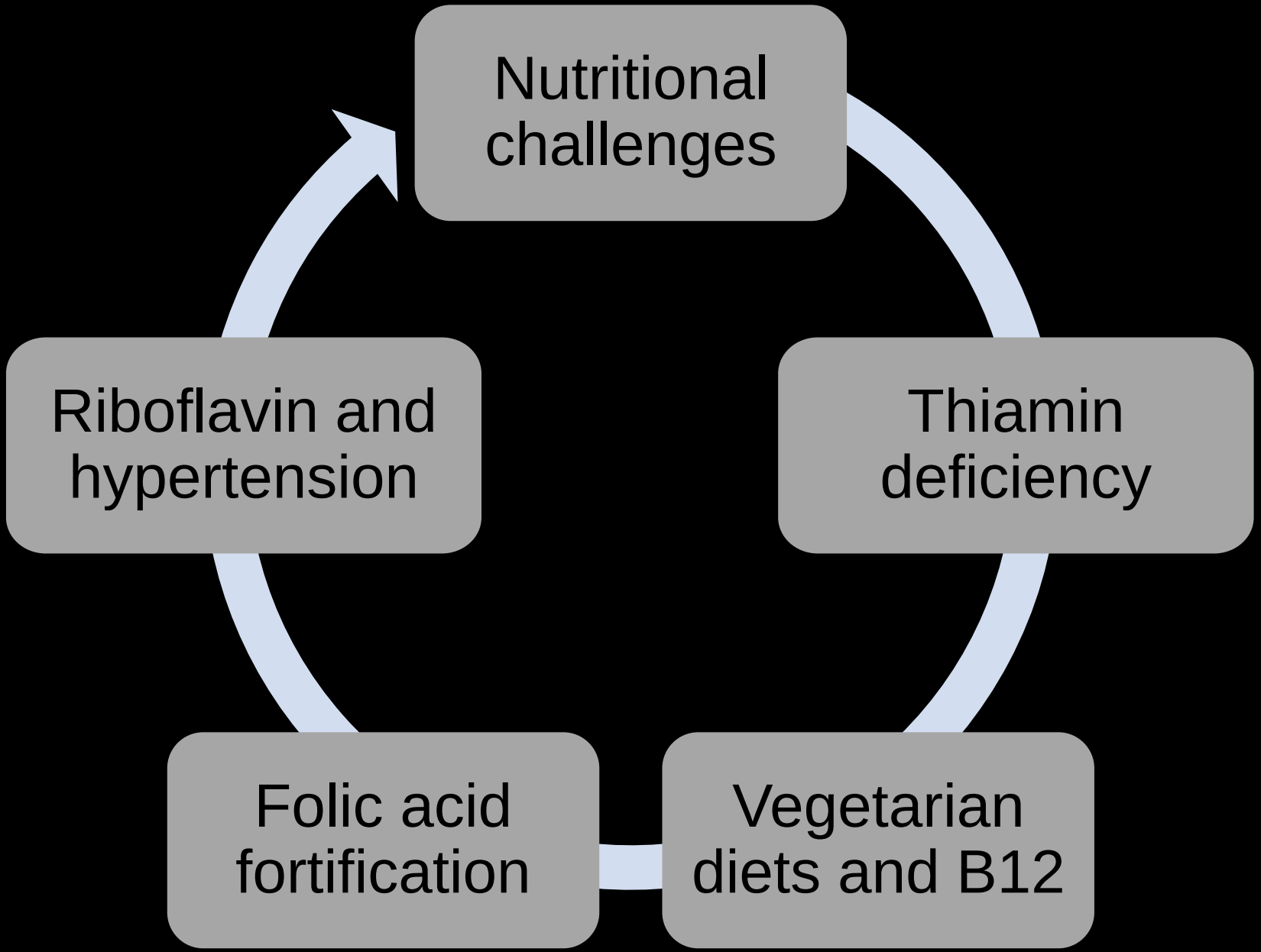
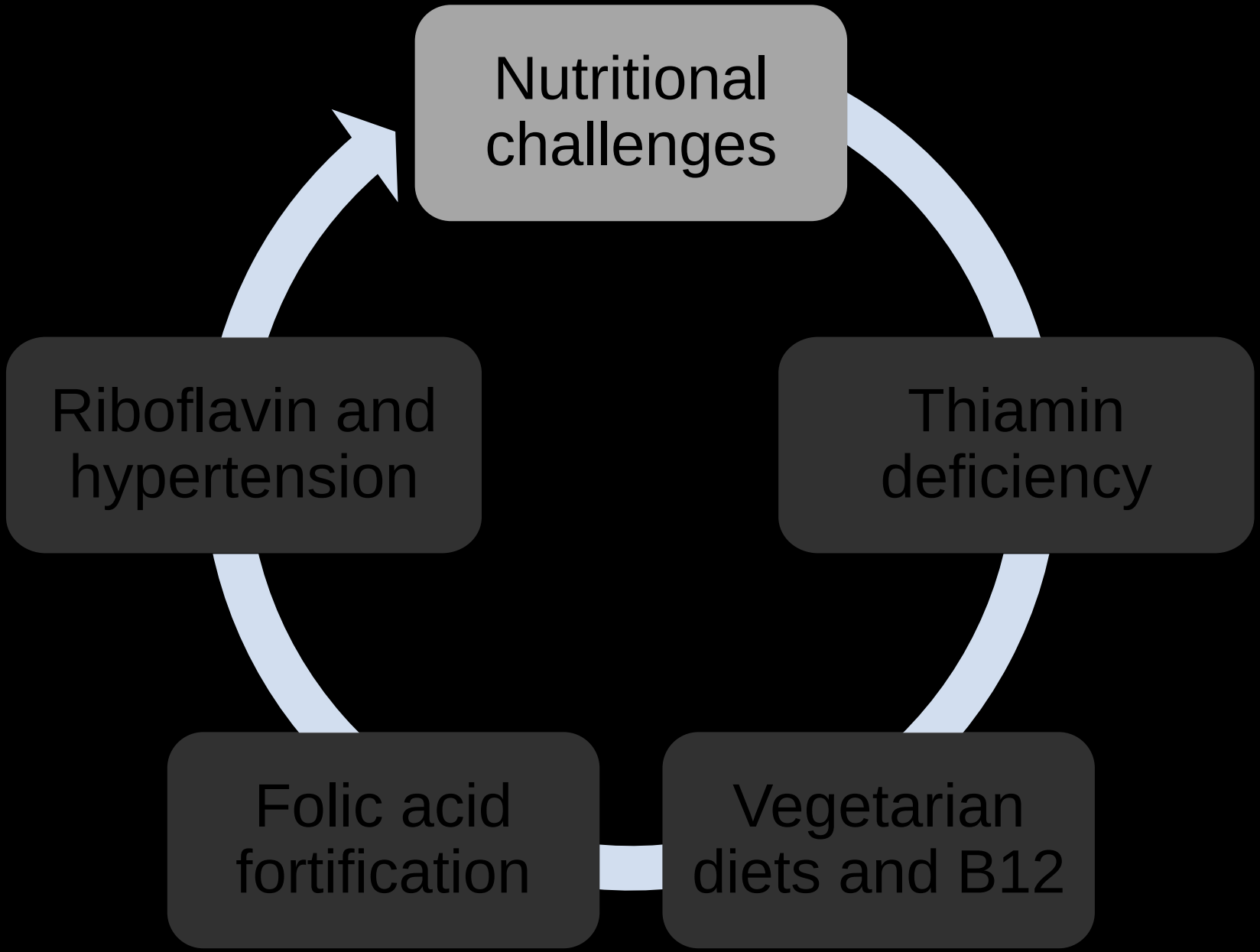
Nutritional challenges related to B-vitamins

Vegard Lysne

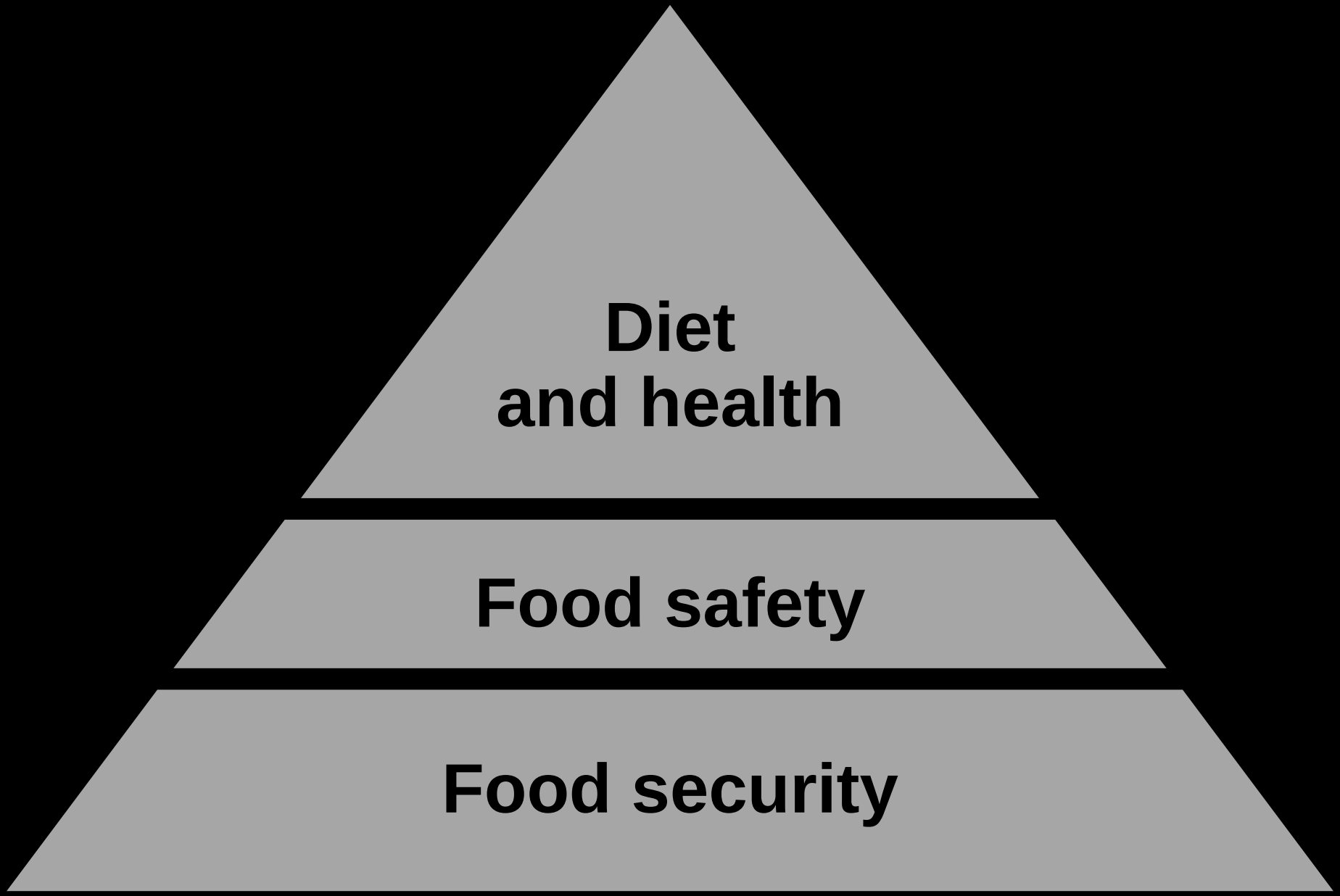
Trial lecture, 04.10.2019

vegard.lysne@uib.no


Nutritional challenges
Thiamin deficiency
Vegetarian diets and B12
Folic acid fortification
Riboflavin and hypertension


Nutritional challenges
Thiamin deficiency
Vegetarian diets and B12
Folic acid fortification
Riboflavin and hypertension

Nutritional challenges


Diet
and health
Food safety
Food security

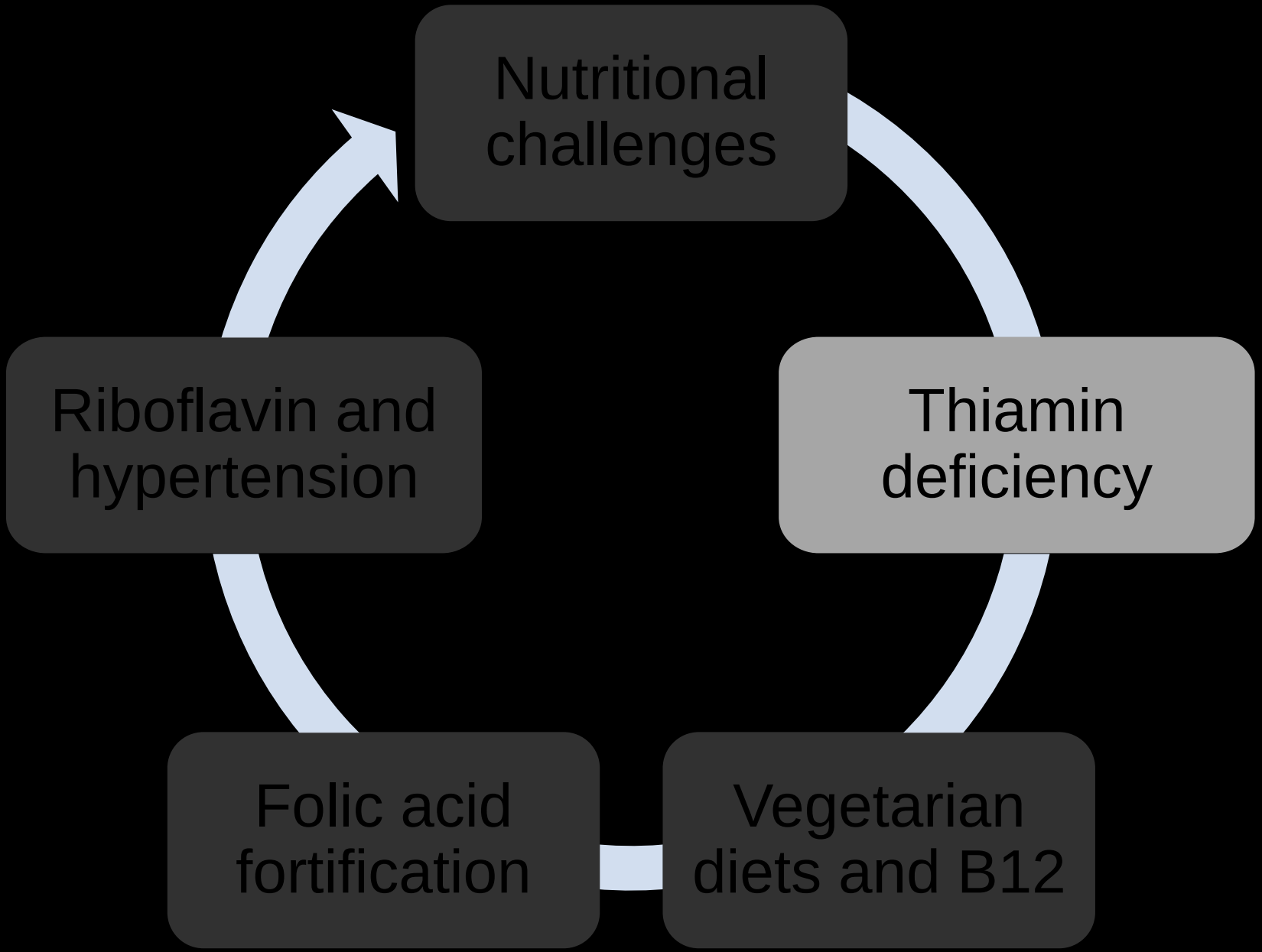
B-vitamins

B1	Thiamin
B2	Riboflavin
B3	Niacin
B5	Pantothenic acid
B6	Pyridoxin
B7	Biotin
B9	Folate
B12	Cobalamin


PAST
PRESENT
FUTURE

PAST

Nutritional deficiencies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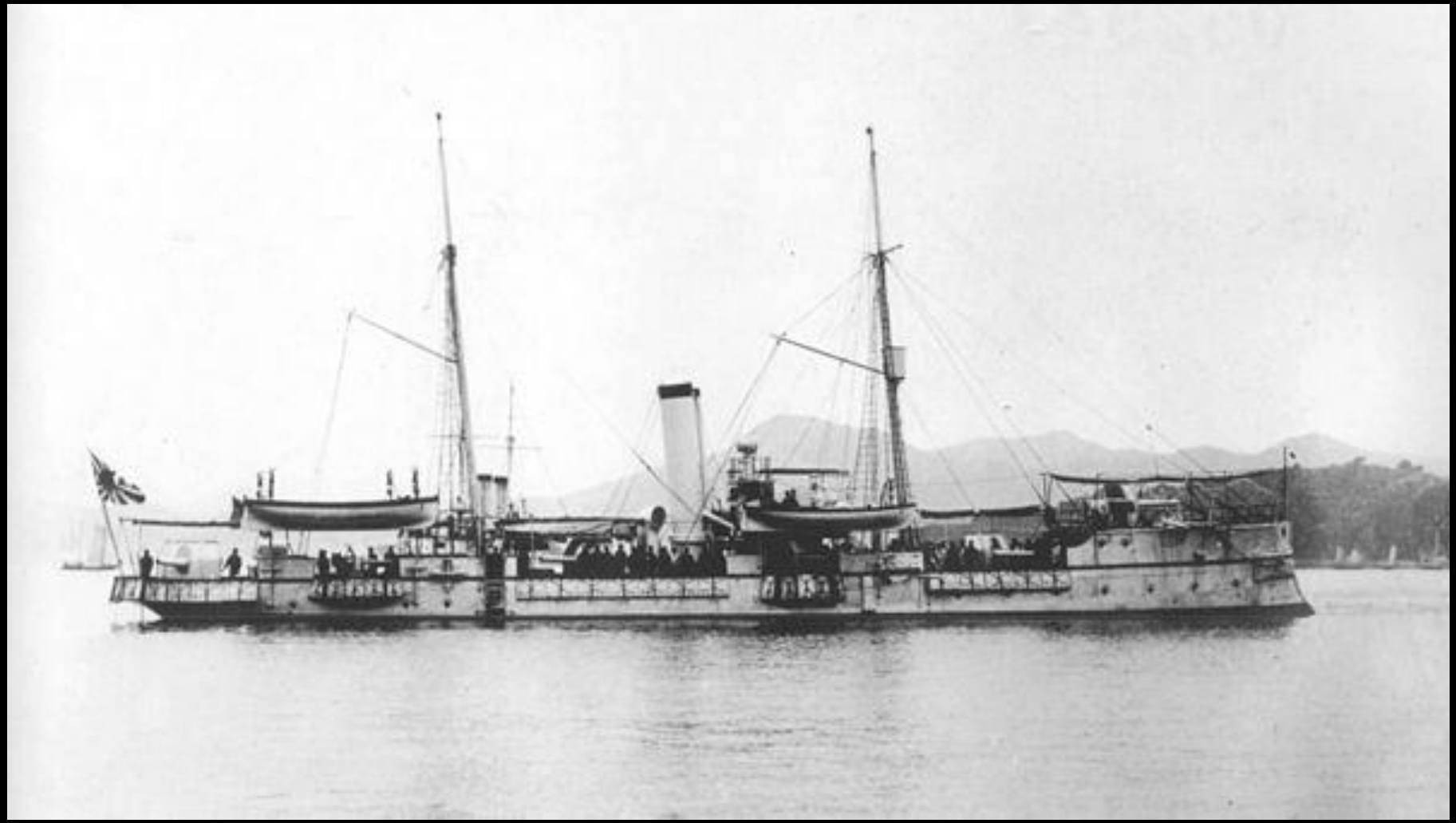
Beriberi

Lonsdale D. Adv Food Nutr Res 2018

Beriberi – a story of rice and men

Lonsdale D. Adv Food Nutr Res 2018, Picture: Colorbox

1800s – Beriberi in the navy

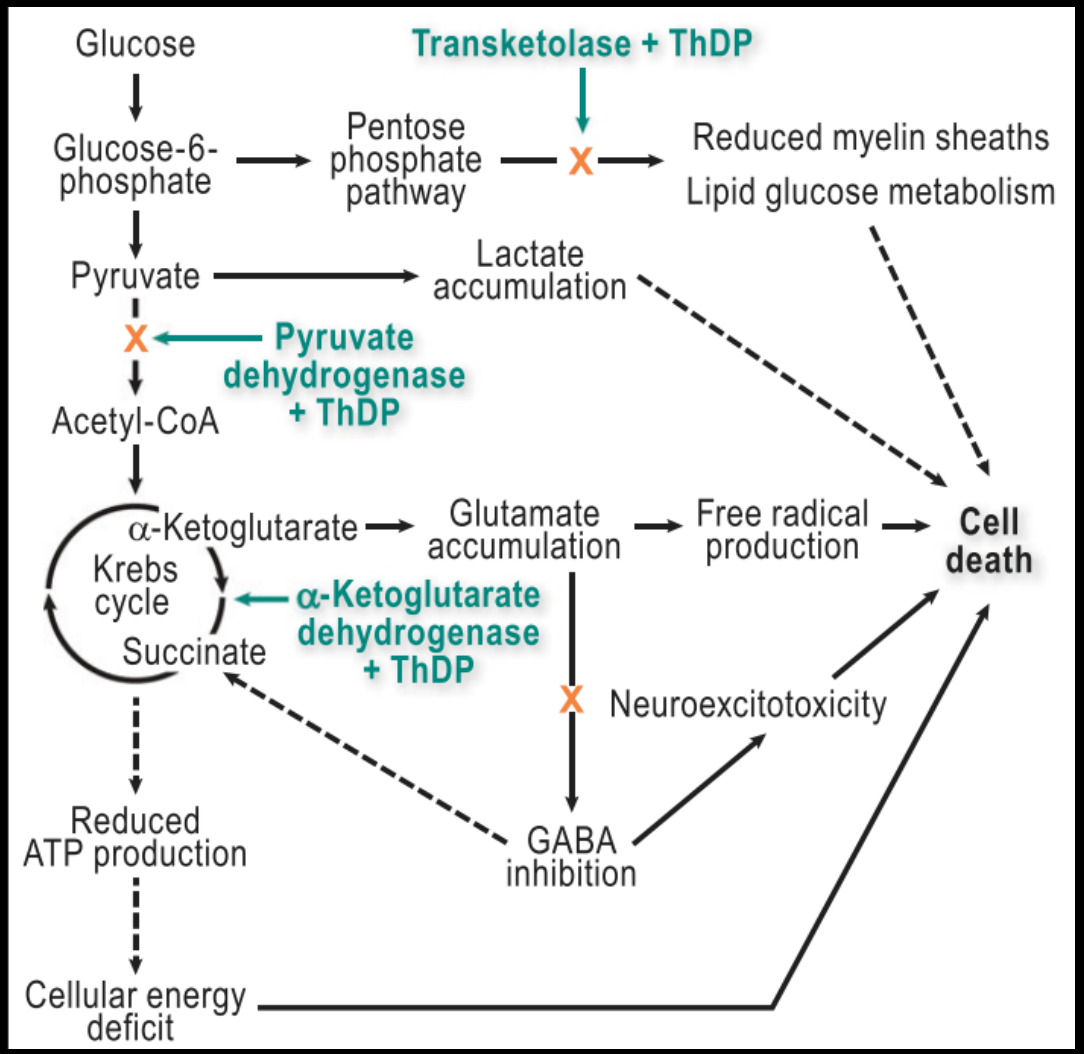


Lonsdale D. Adv Food Nutr Res 2018, Picture: wakiwand.com

Discovery of thiamin

Lonsdale D. Adv Food Nutr Res 2018, Picture: Canva

Thiamin deficiency mechanism

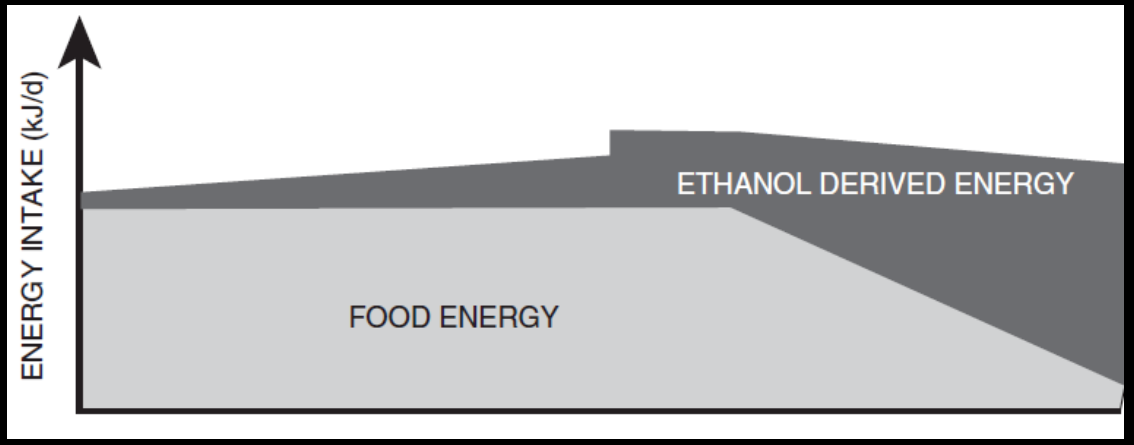


Whitfield KC *et al*. Ann N Y Acad Sci 2018

Thiamin deficiency today

Chronic alcoholism

- Wernicke-Korsakoff syndrome



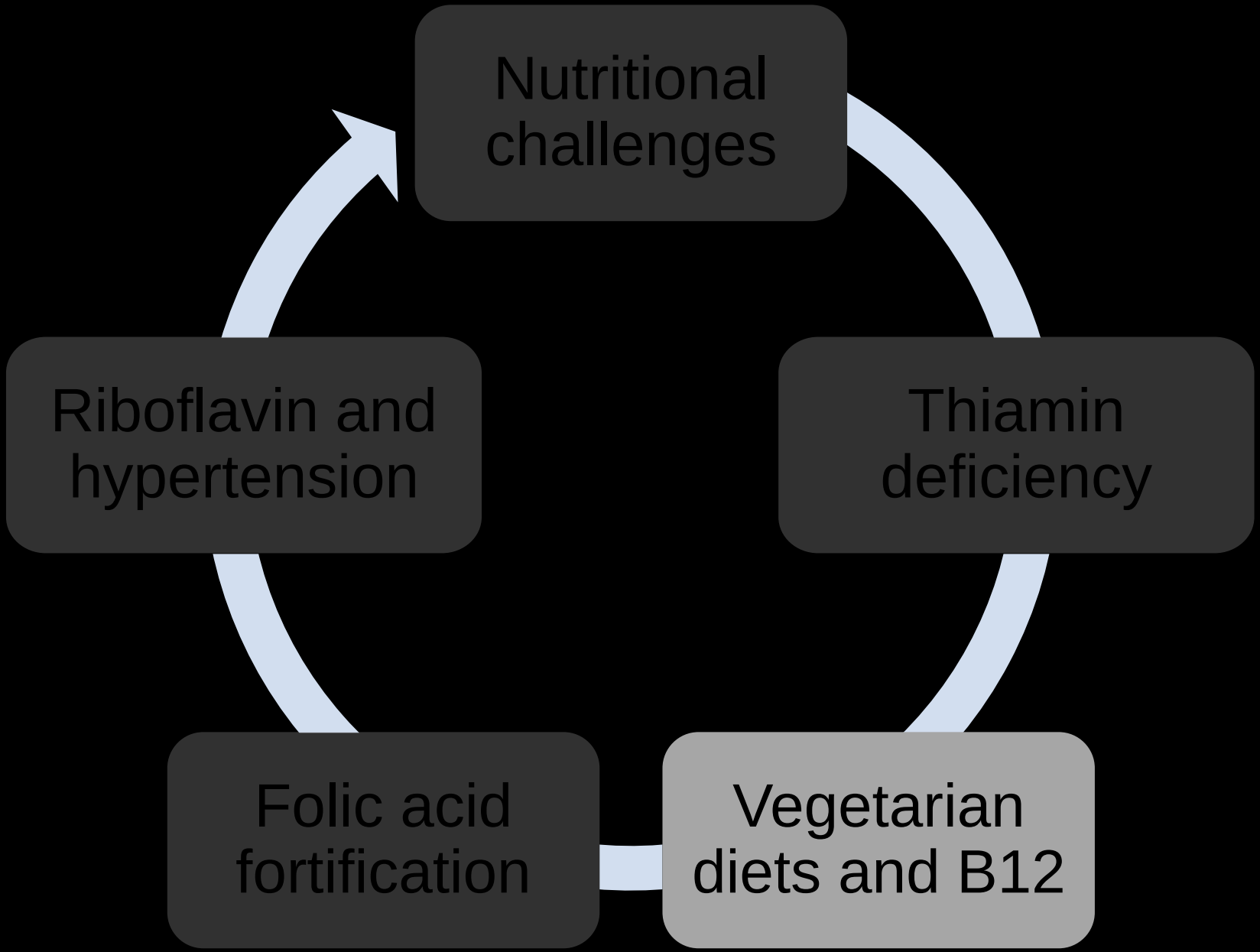
Low-thiamin staple foods

- Poverty
- Isolated subpopulations

Suter P. Present Knowledge in Nutrition 2012, Whitfield KC et al. Ann N Y Acad Sci 2018

PRESENT

Dietary trends, recommendations and nutrition policy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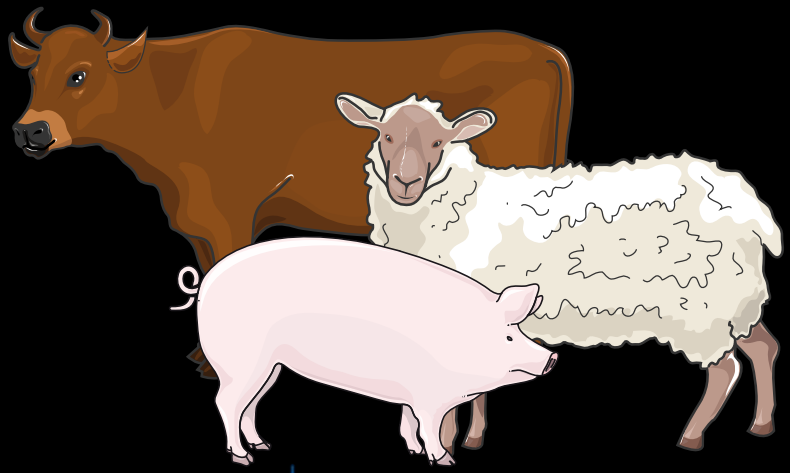
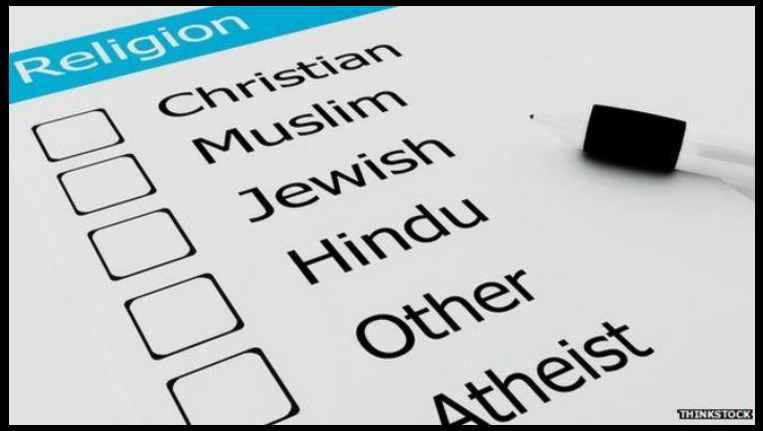
What is a vegetarian diet?

	Plants	Dairy	Egg	Fish	Poultry	Meat
Omnivore	✓	✓	✓	✓	✓	✓
Vegan	✓	✗	✗	✗	✗	✗
Lacto-vegetarian	✓	✓	✗	✗	✗	✗
Ovo-vegetarian	✓	✗	✓	✗	✗	✗
Pescetarian	✓	✗	✗	✓	✗	✗
Flexitarian	✓	(✓)	(✓)	(✓)	(✓)	(✓)

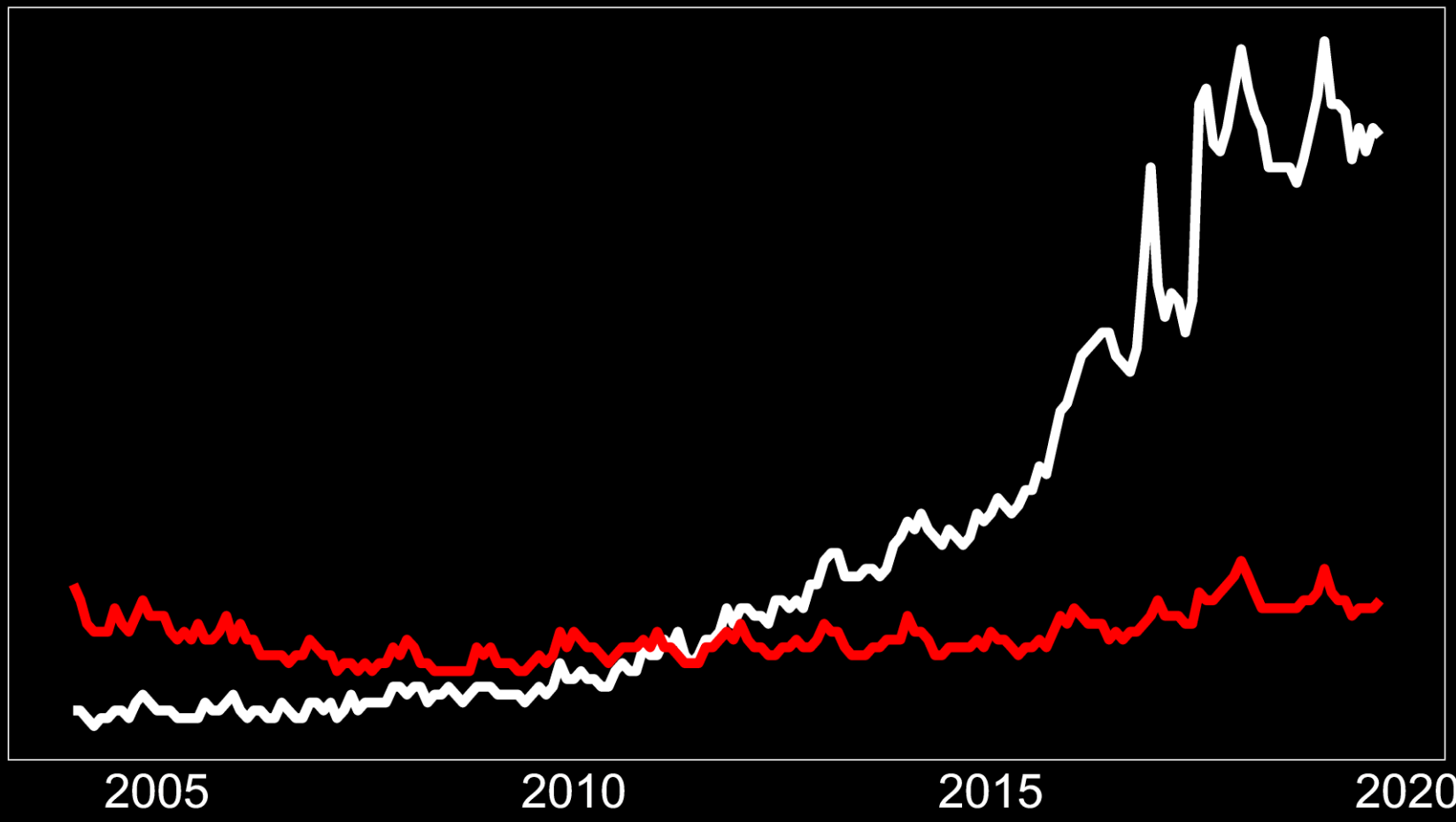
Motivations

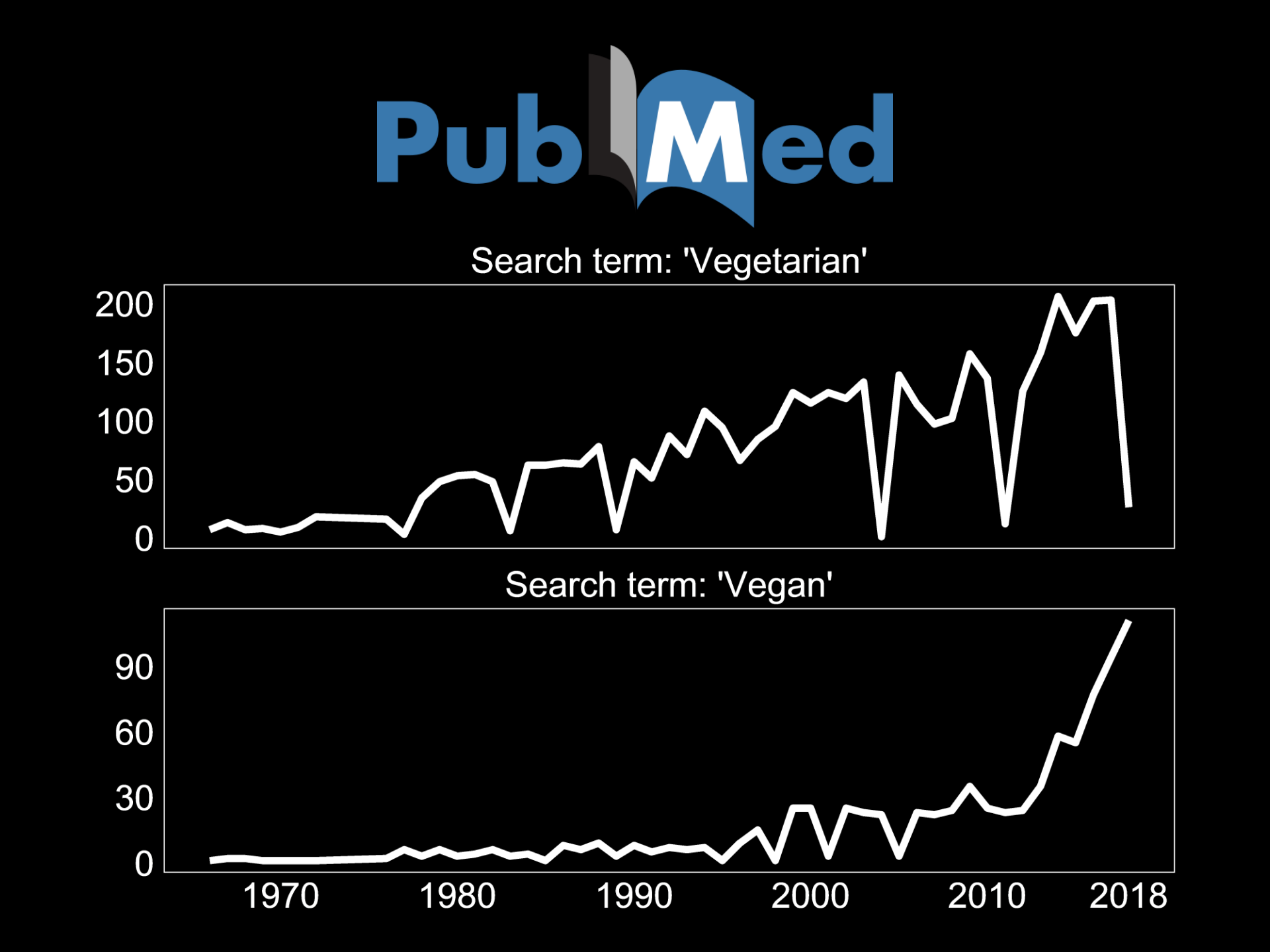




Rosenfeld D & Burrow A. Appetite 2017

Google




PubMed
Search term: 'Vegetarian'
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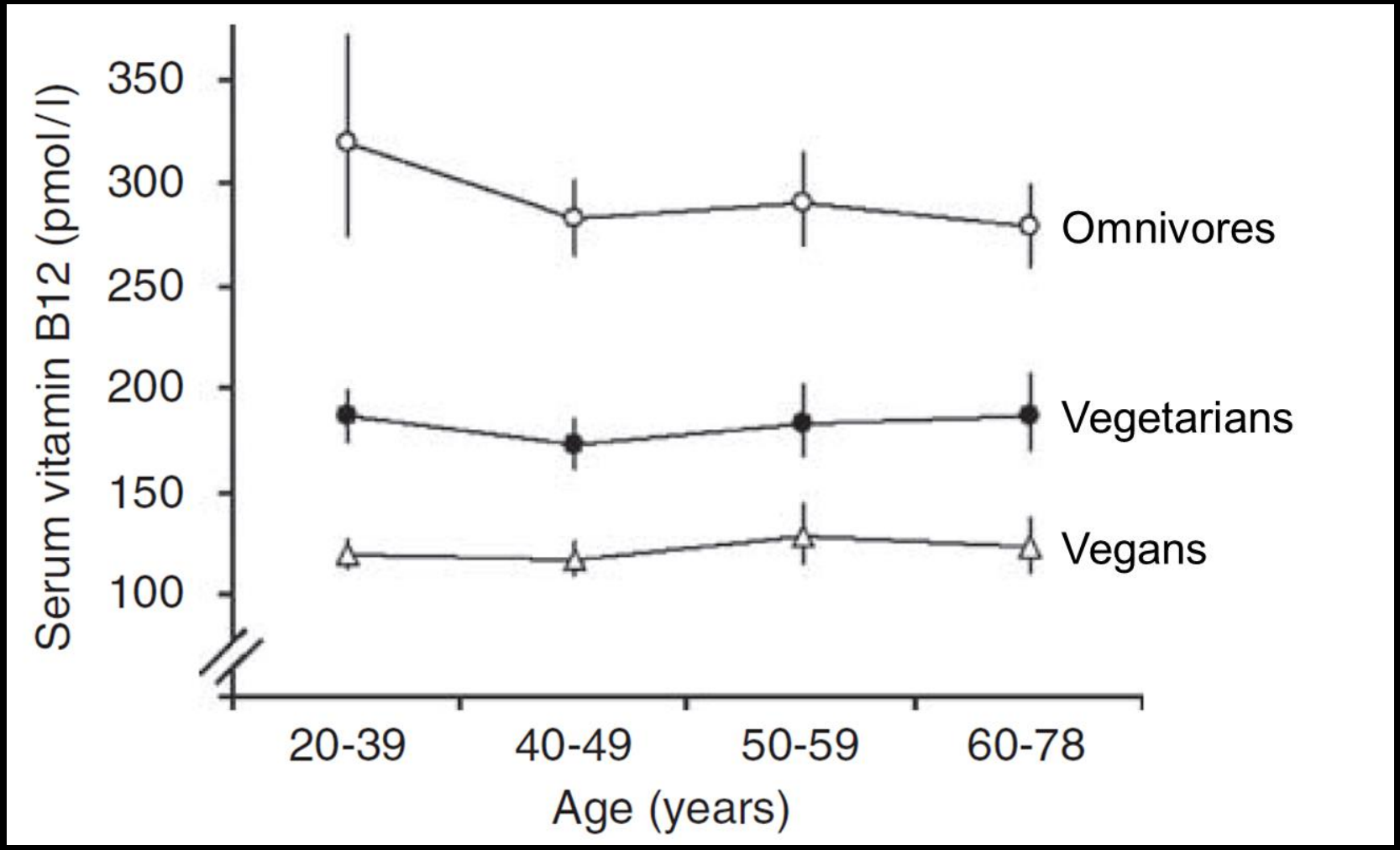
150
100
50
0
Search term: 'Vegan'
90
60
30
0
1970
1980
1990
2000
2010
2018

Vegetarians and B12 status



Gilsing AMJ *et al*. Eur J Clin Nutr 2010

Current recommendations

Recommended intake

- 2 µg/d (mean intake 5-7 µg/d)

Vegans

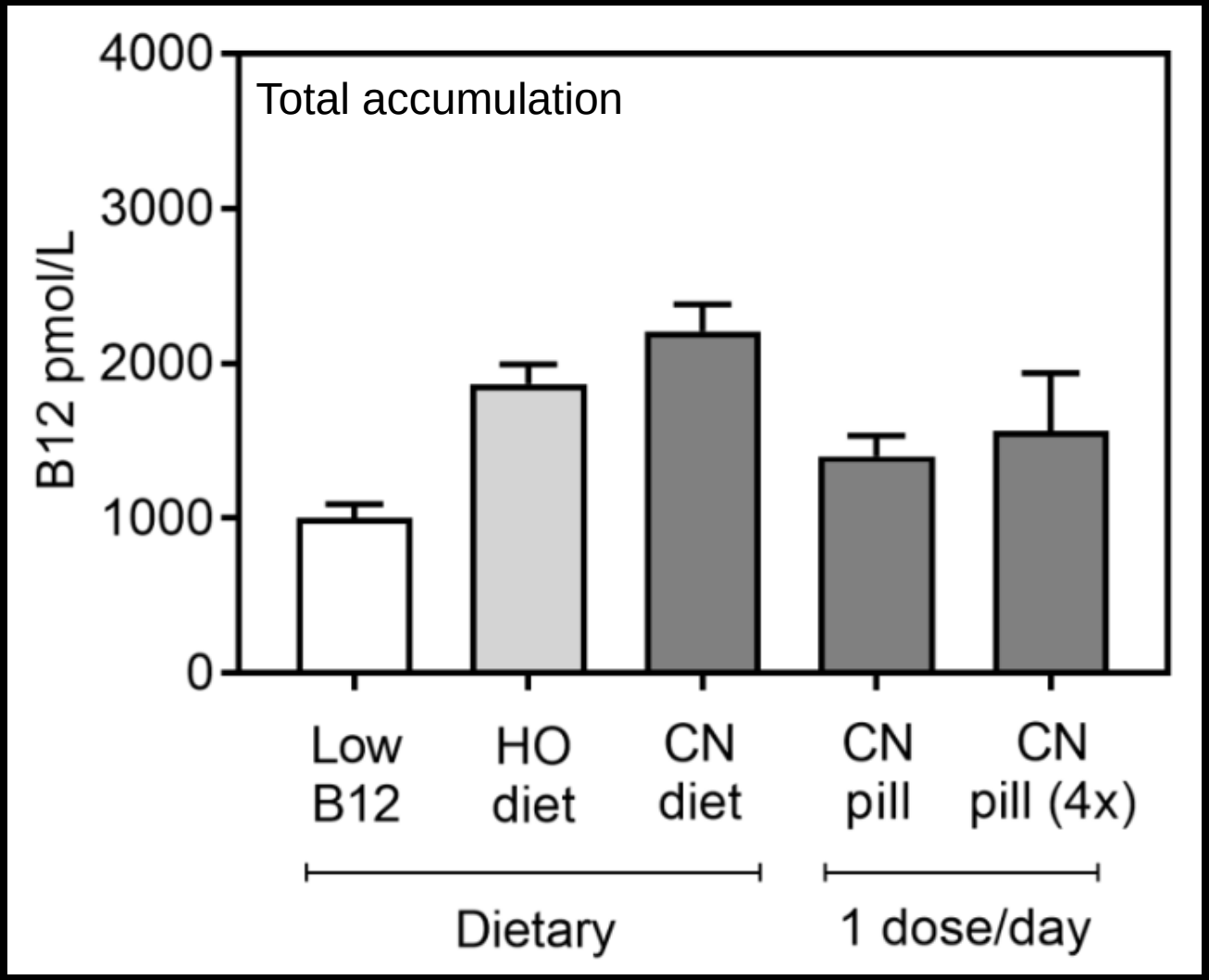
- Diet must be supplemented with B12

Vegetarians

- Low B12 status common
- Consider supplement

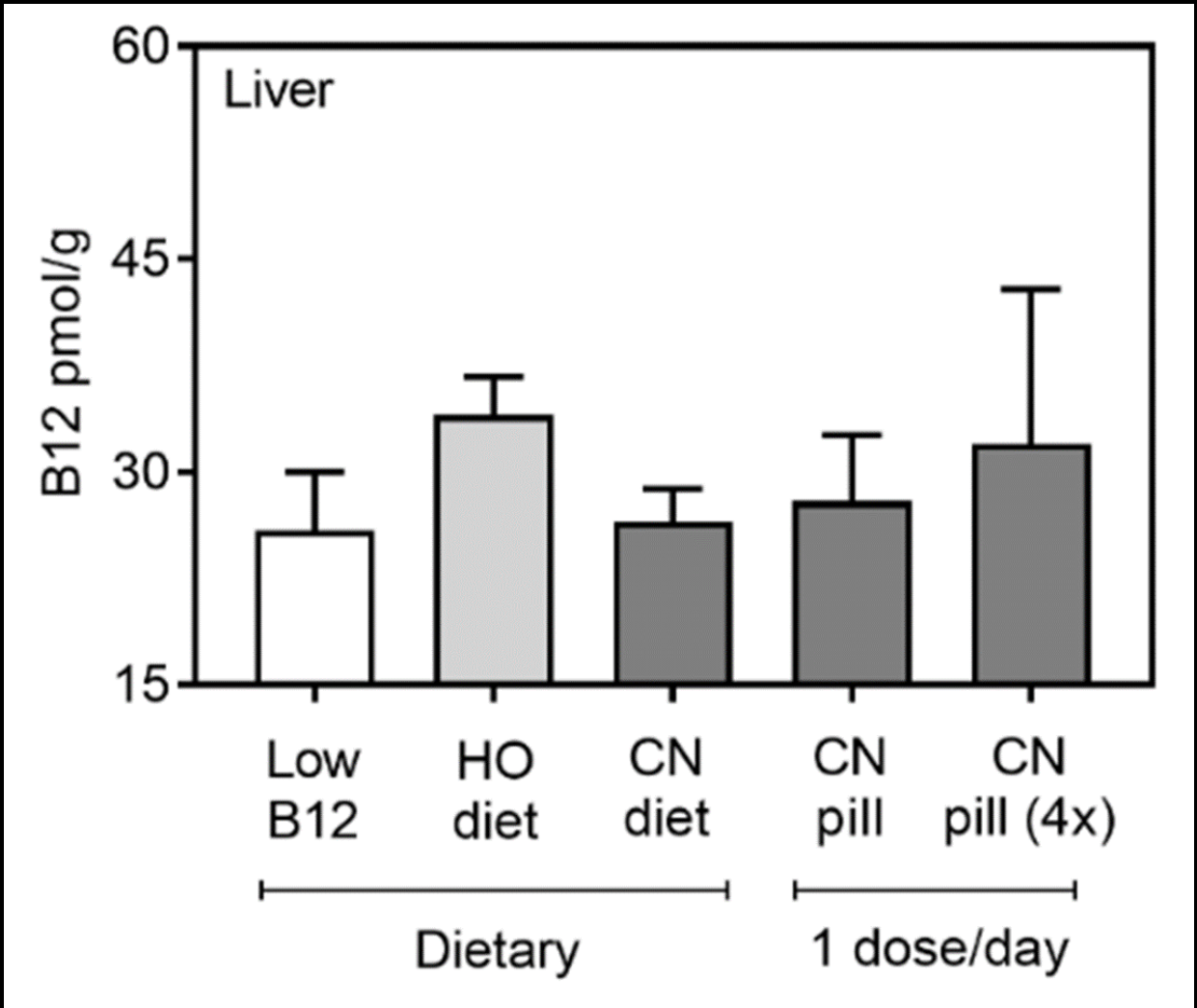
Nordic Nutrition Recommendations, 2012

Dietary B12 vs supplement



Greibe E *et al* (2018). Nutrients

Dietary B12 vs supplement



Greibe E *et al* (2018). Nutrients

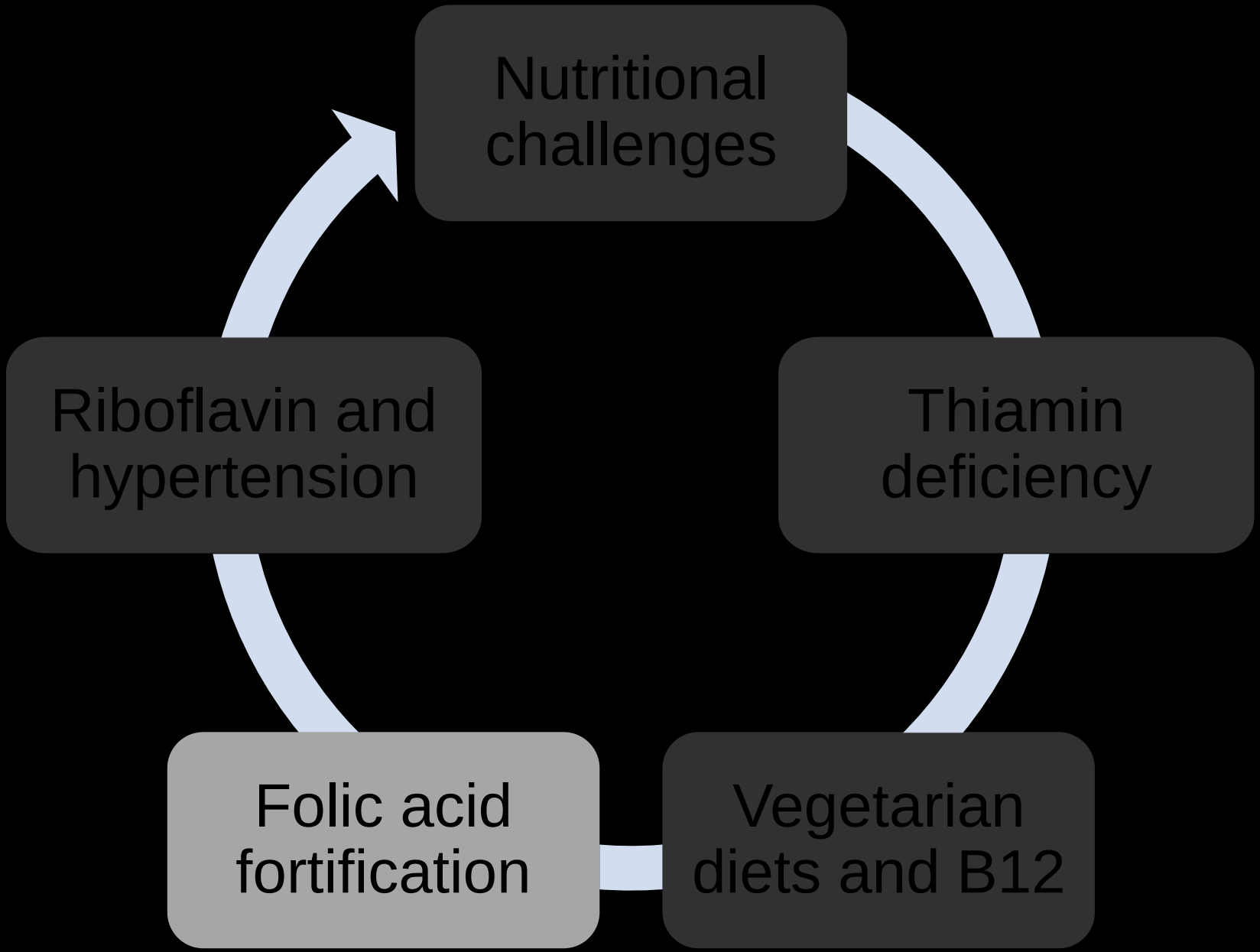
Vegans and B12

Supplement the diet!

Higher dose?

Split the dose

Should vegetarians also supplement?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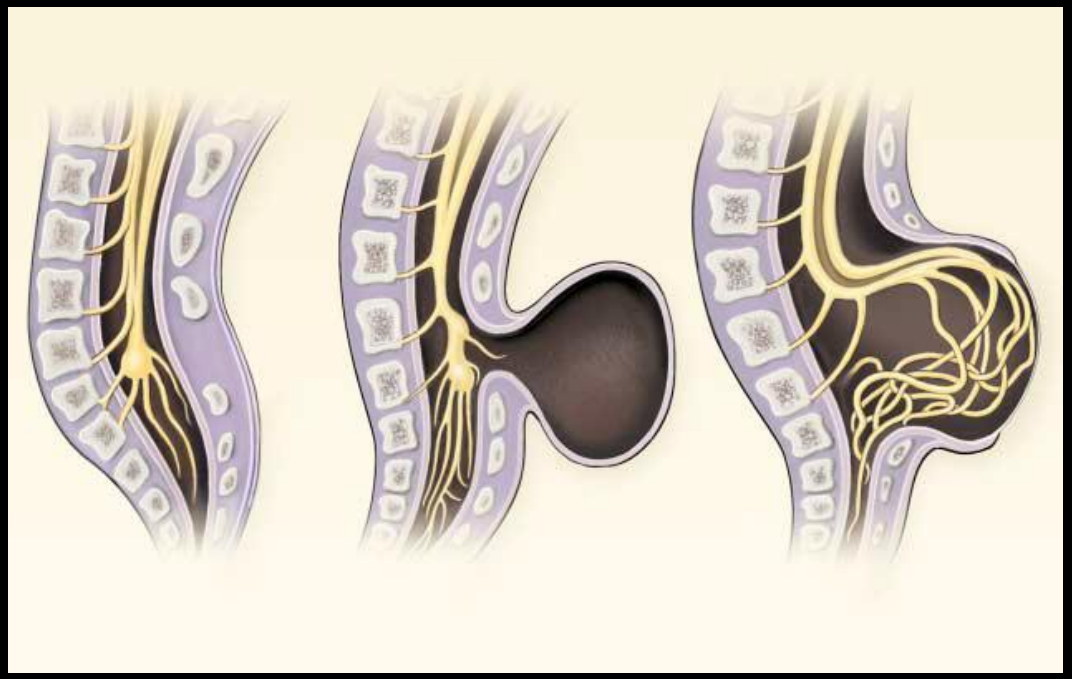
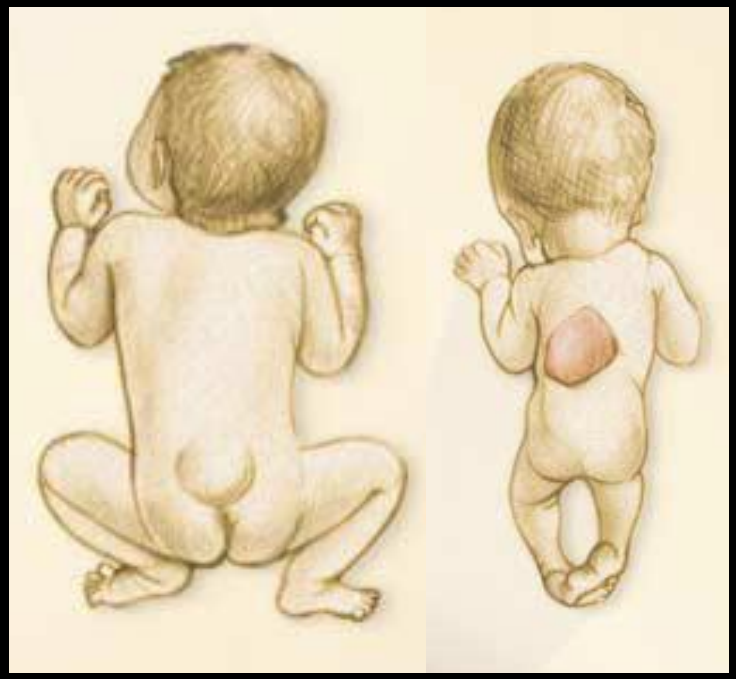
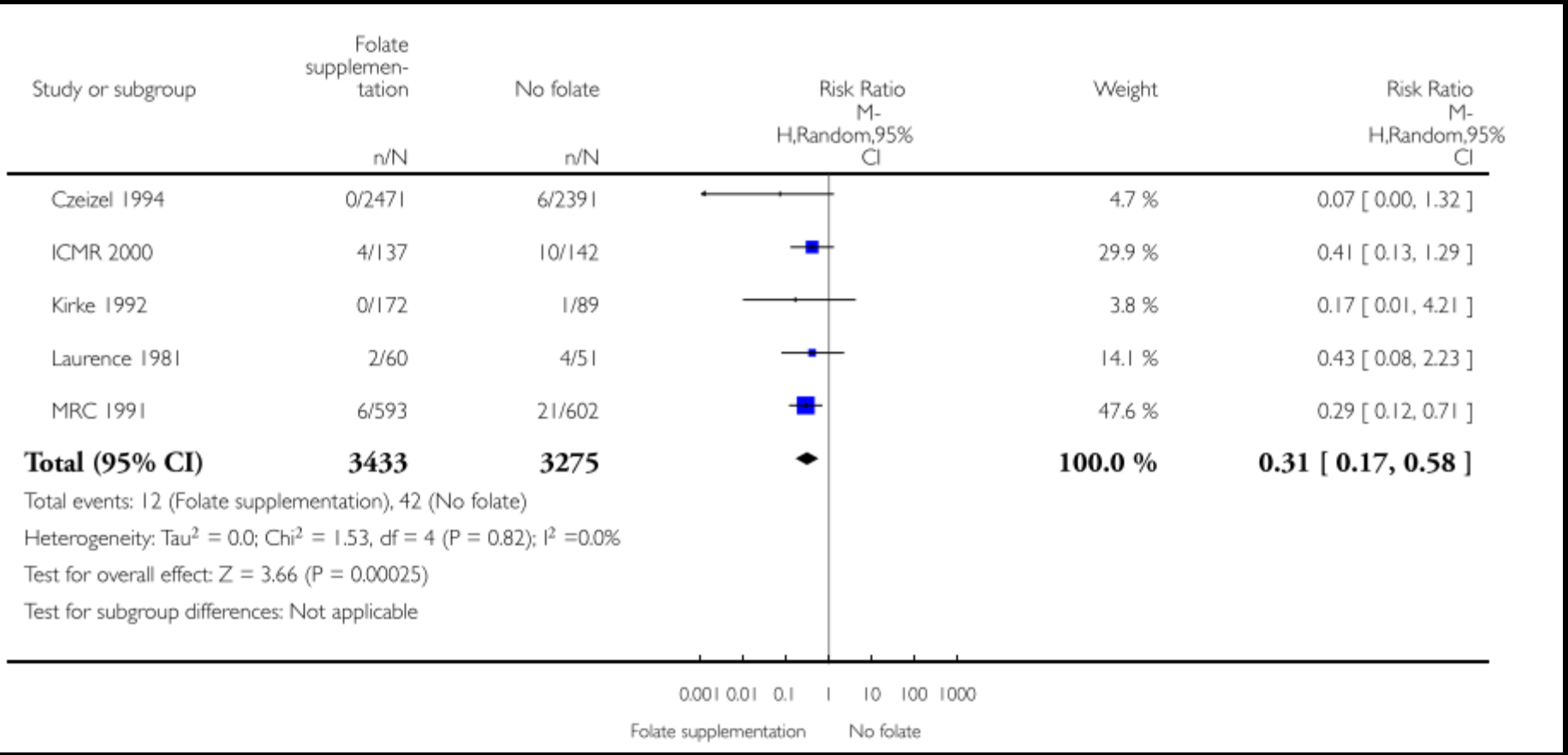
Neural tube defects





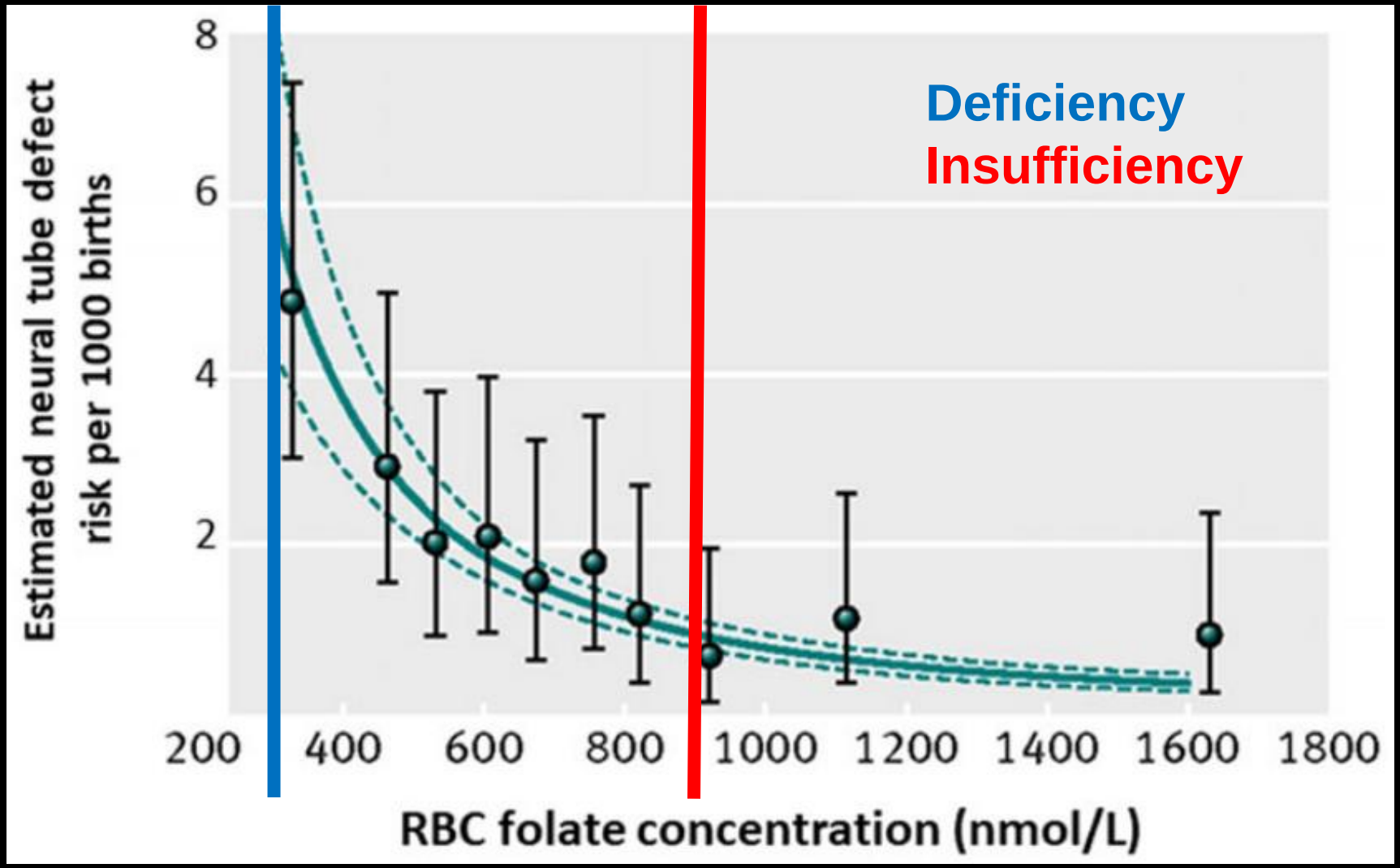
Picture adapted from Botto LD *et al*. N Eng J Med

Folic acid supplementation



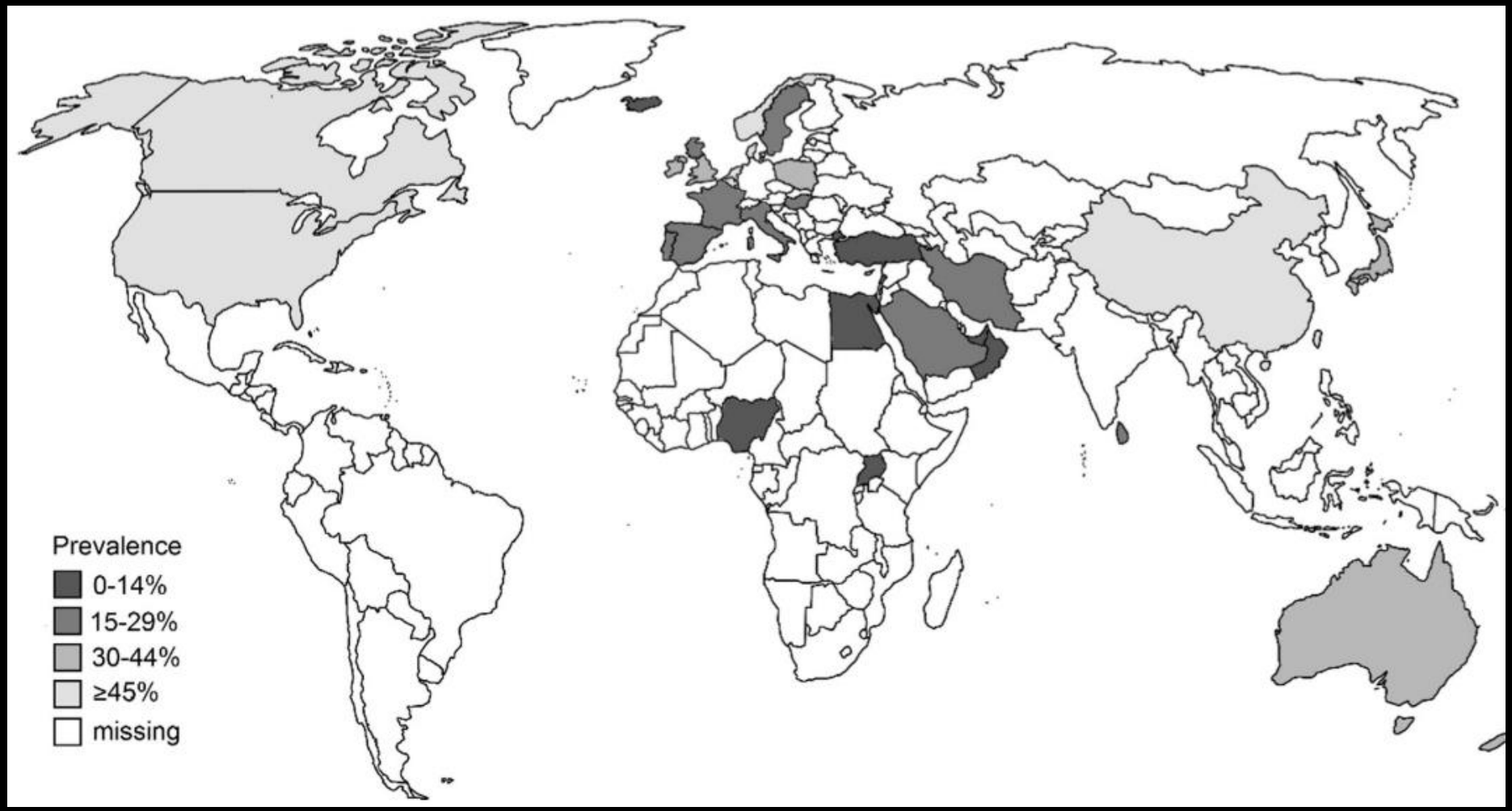
De-Regil LM *et al*. Cochrane Database Syst Rev 2015

Folate status and NTD risk



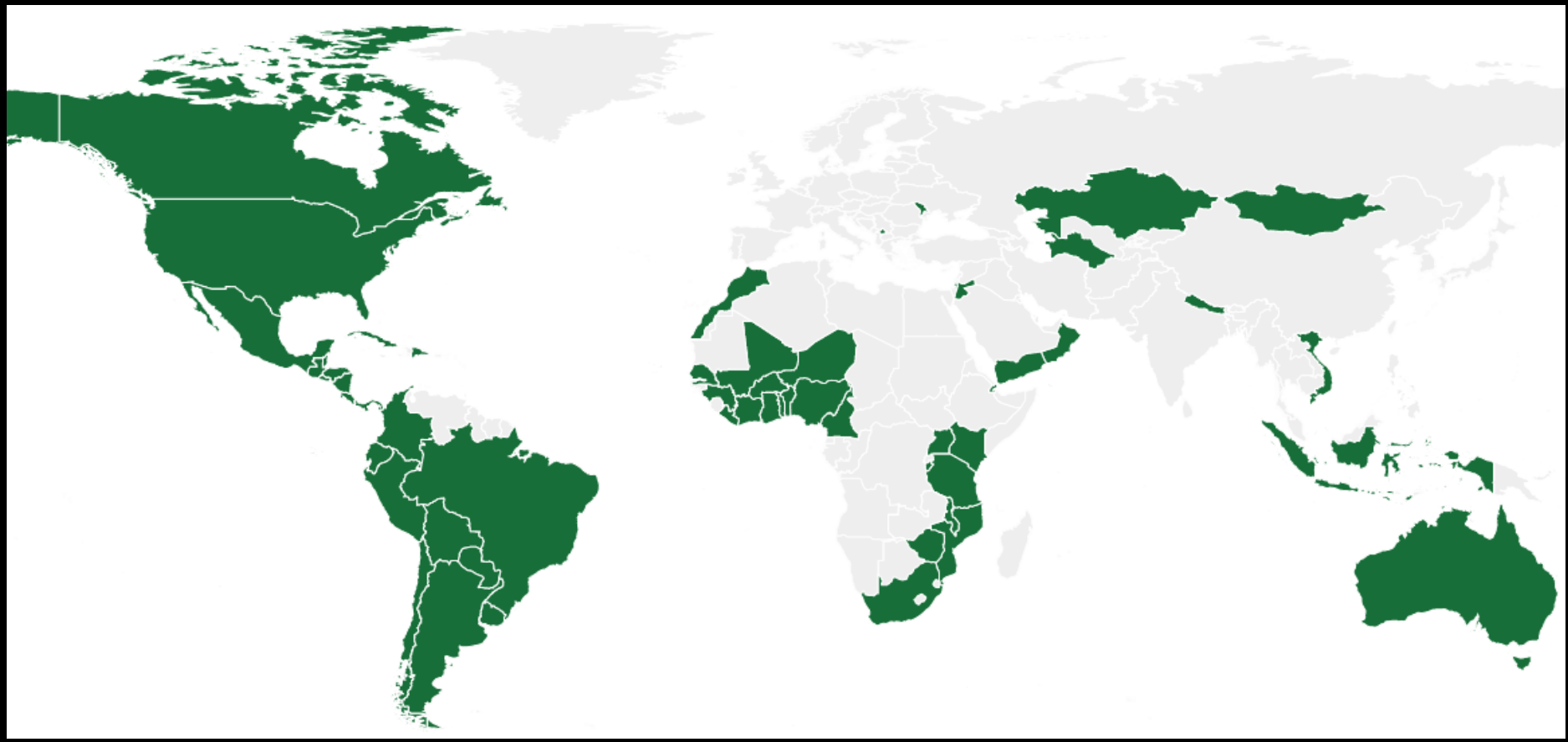
Bailey LB & Hausman DB. Ann N Y Acad Sci 2018

Supplement compliance



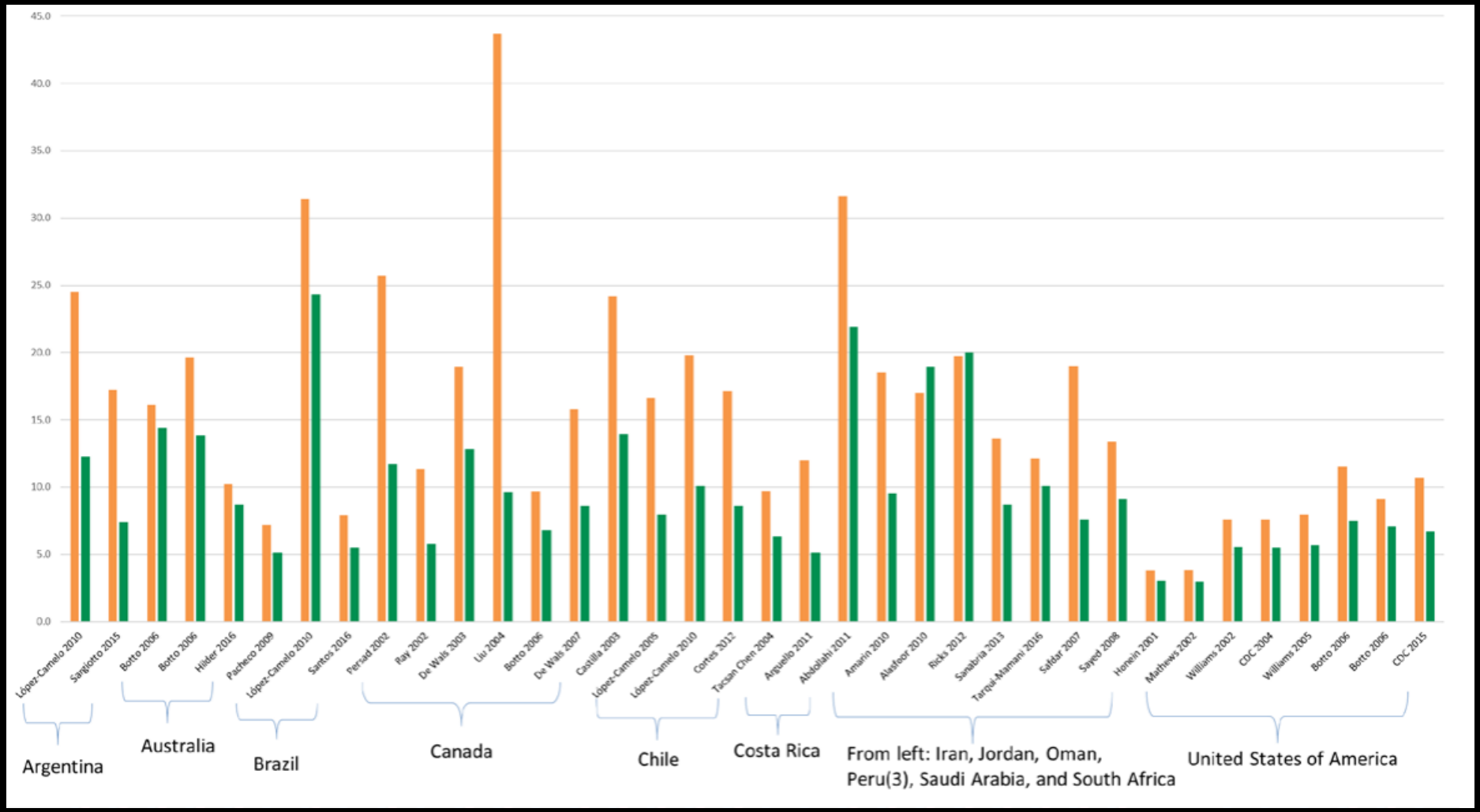
Toivonen, KI *et al*. Prev Med, 2018

Mandatory folic acid fortification



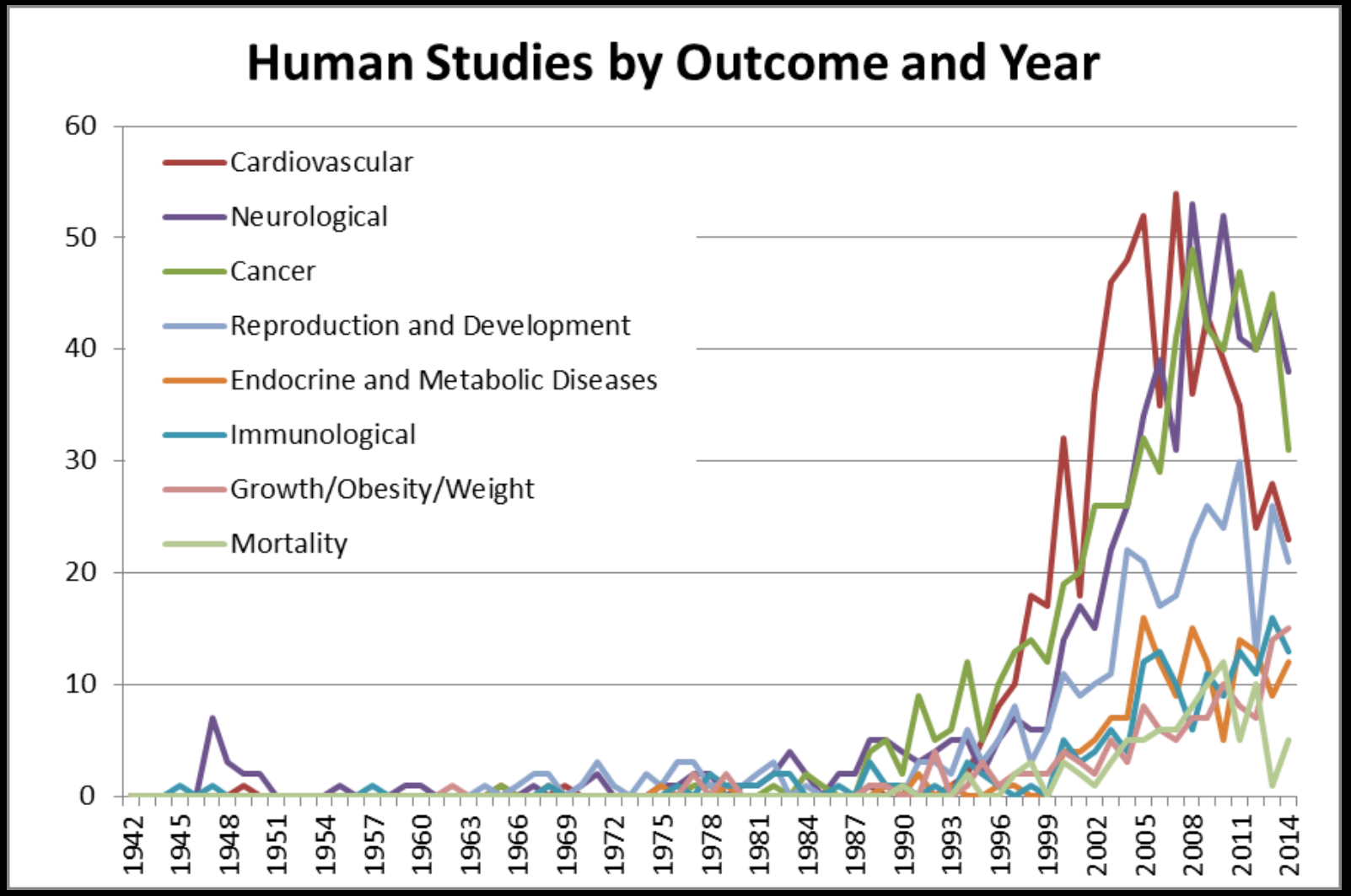
www.fortificationdata.org

NTD's PRE vs POST fortification



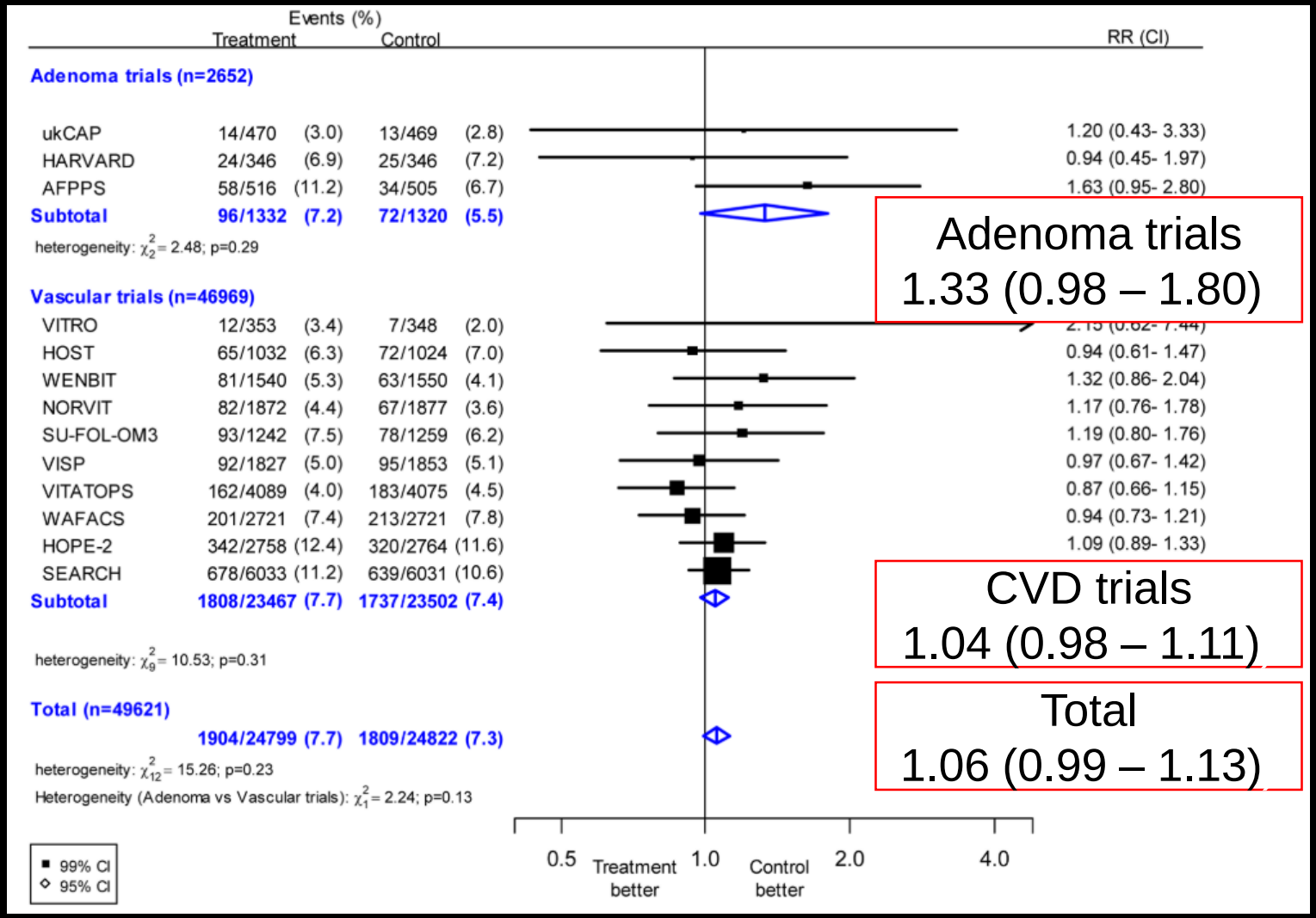
Atta C *et* al. Am J Public health, 2016. Figure: Food Fortification Initiative, 2018

The controversy



National Toxicology Program (NTP) monograph, 2015

Folic acid and cancer



Vollset SE *et al*. Lancet, 2013

Folic acid and cancer

Antifolates used in cancer treatment

Folate deficiency increases cancer risk

The dual role of folate

- Prevent cancer initiation
- Promote cancer development

Kim, YI. Am J Clin Nutr, 2018

Supplement or fortify?

Major nutrition policy challenge

Affects everyone

Definitive benefit on neural tube defects

Potential harms in subgroups?

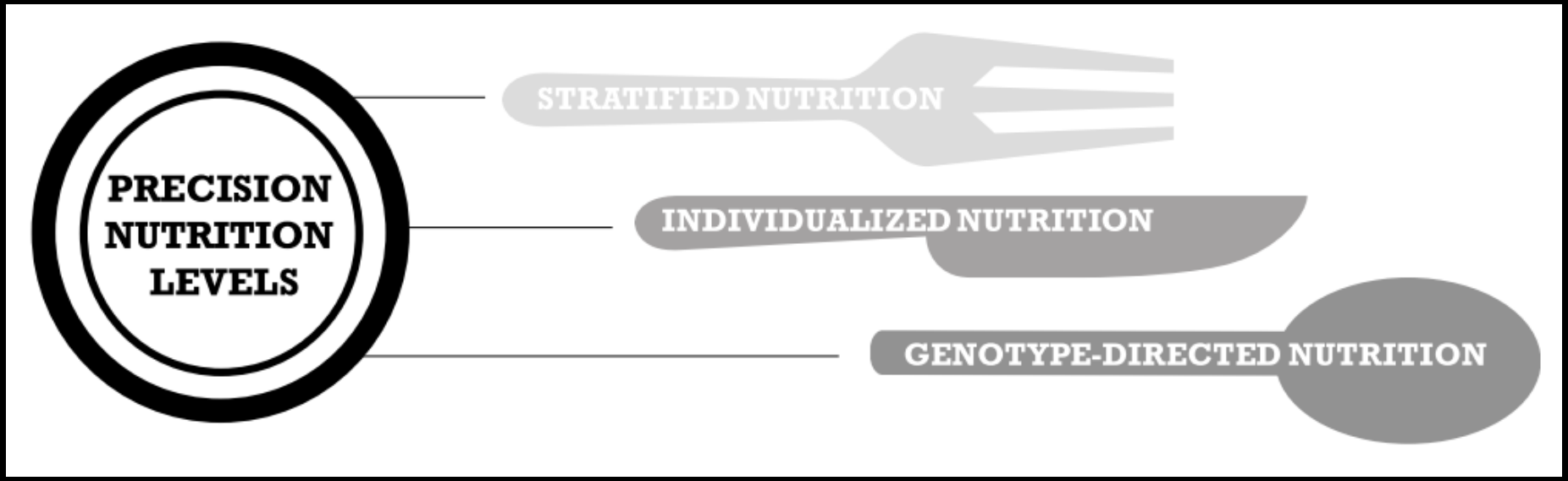
- Cancer
- B12 deficient

FUTURE

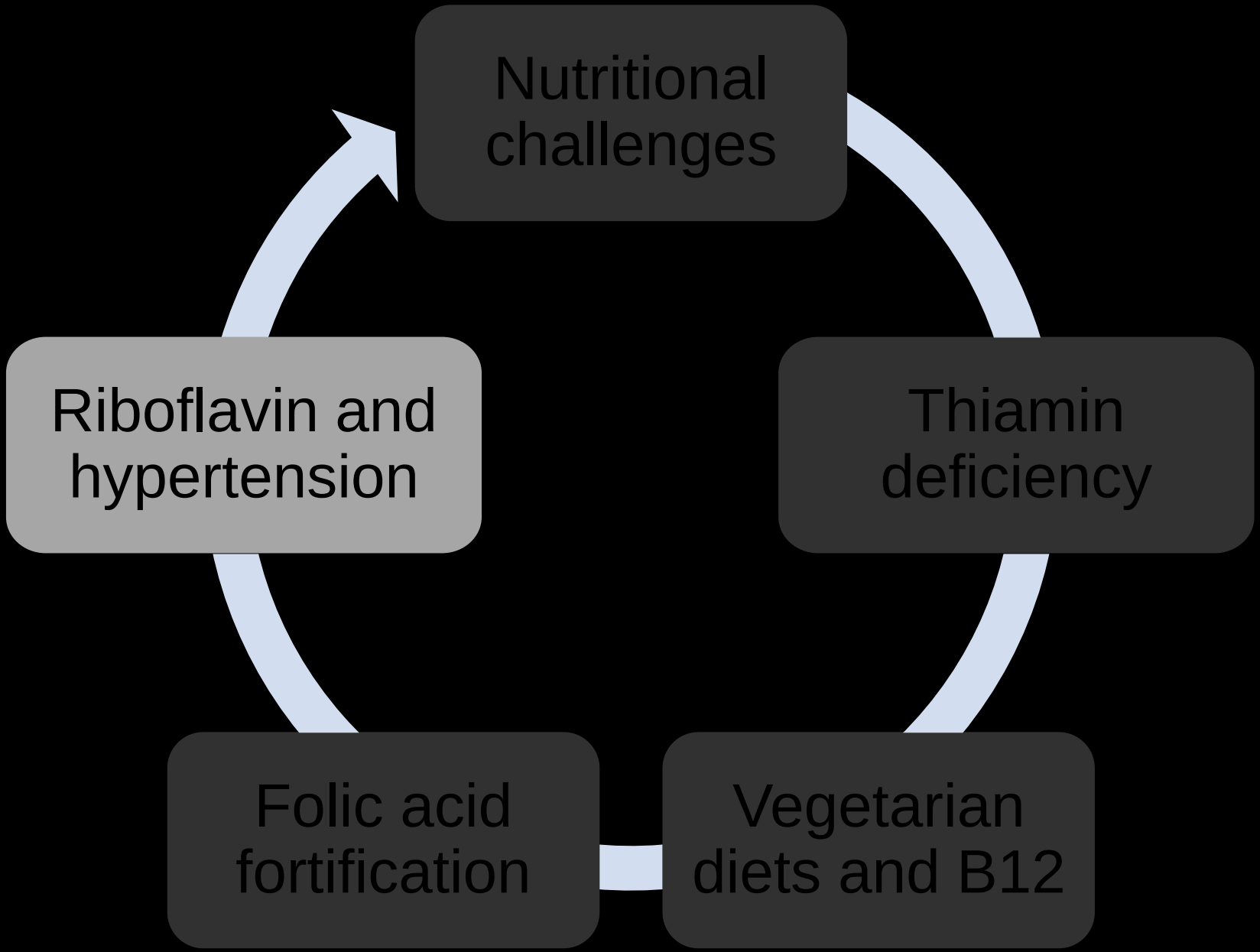
Precision nutrition

Precision nutrition

Tailored nutritional recommendations to treat or prevent metabolic disorders



de Toro-Martín J *et al*. Nutrients 2017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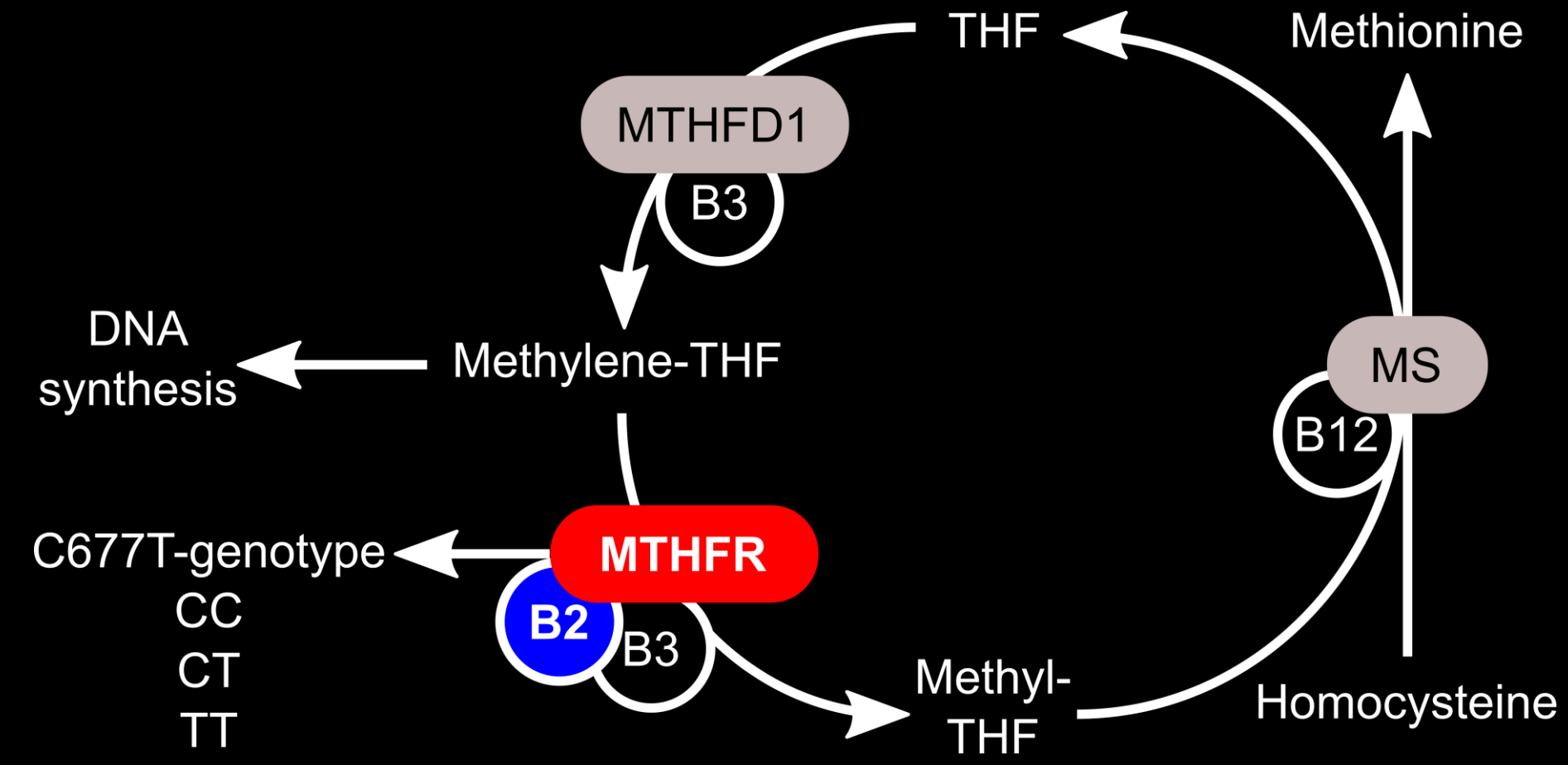
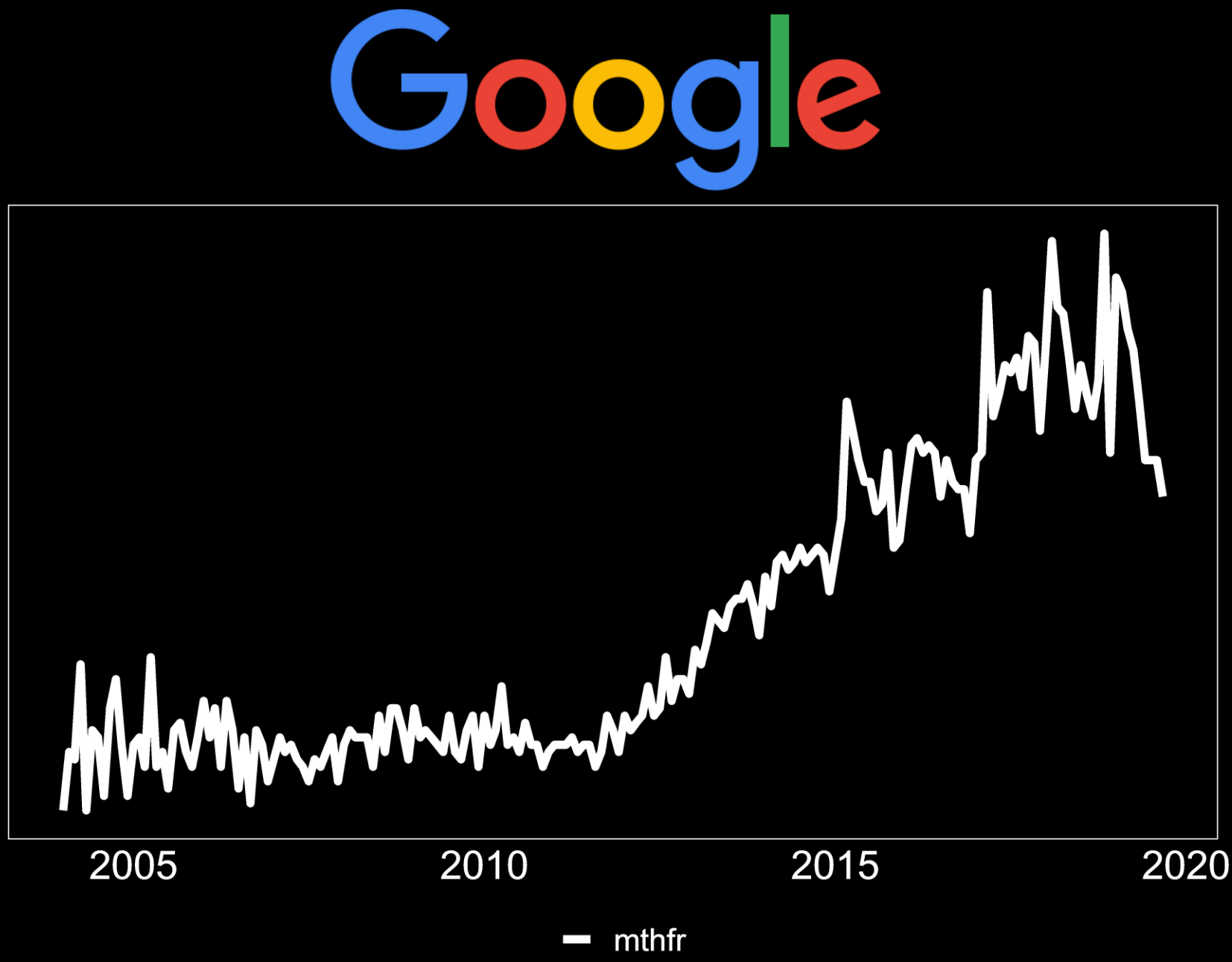
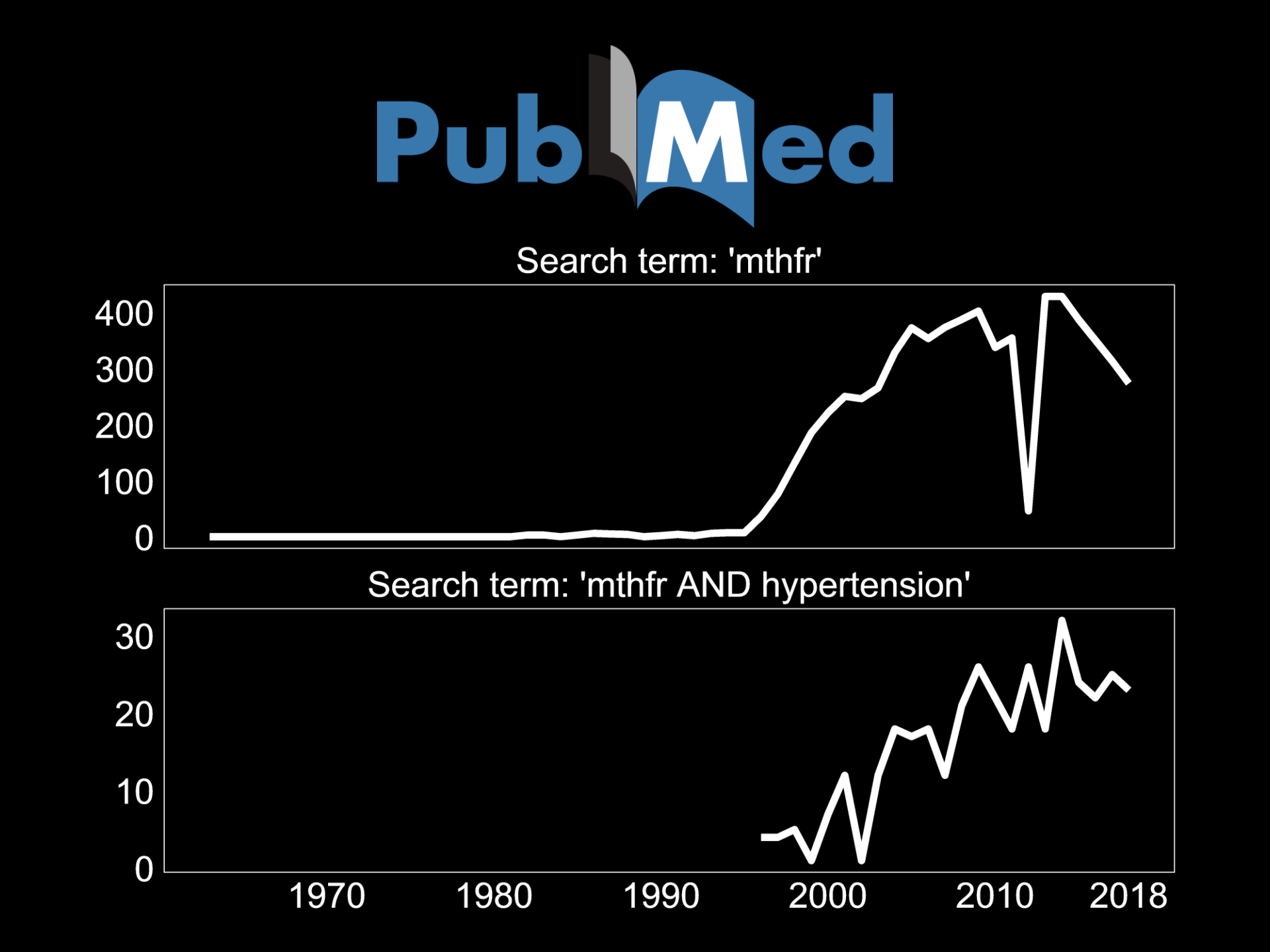
MTHFR


THF
Methionine
MTHFD1
B3
DNA
synthesis
Methylene-THF
MS
B12
C677T-genotype
CC
CT
TT
MTHFR
B2
B3
Methyl-
THF
Homocysteine


Google
2005
2010
2015
2020
mthfr


PubMed
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Search term: 'mthfr AND hypertension'
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20
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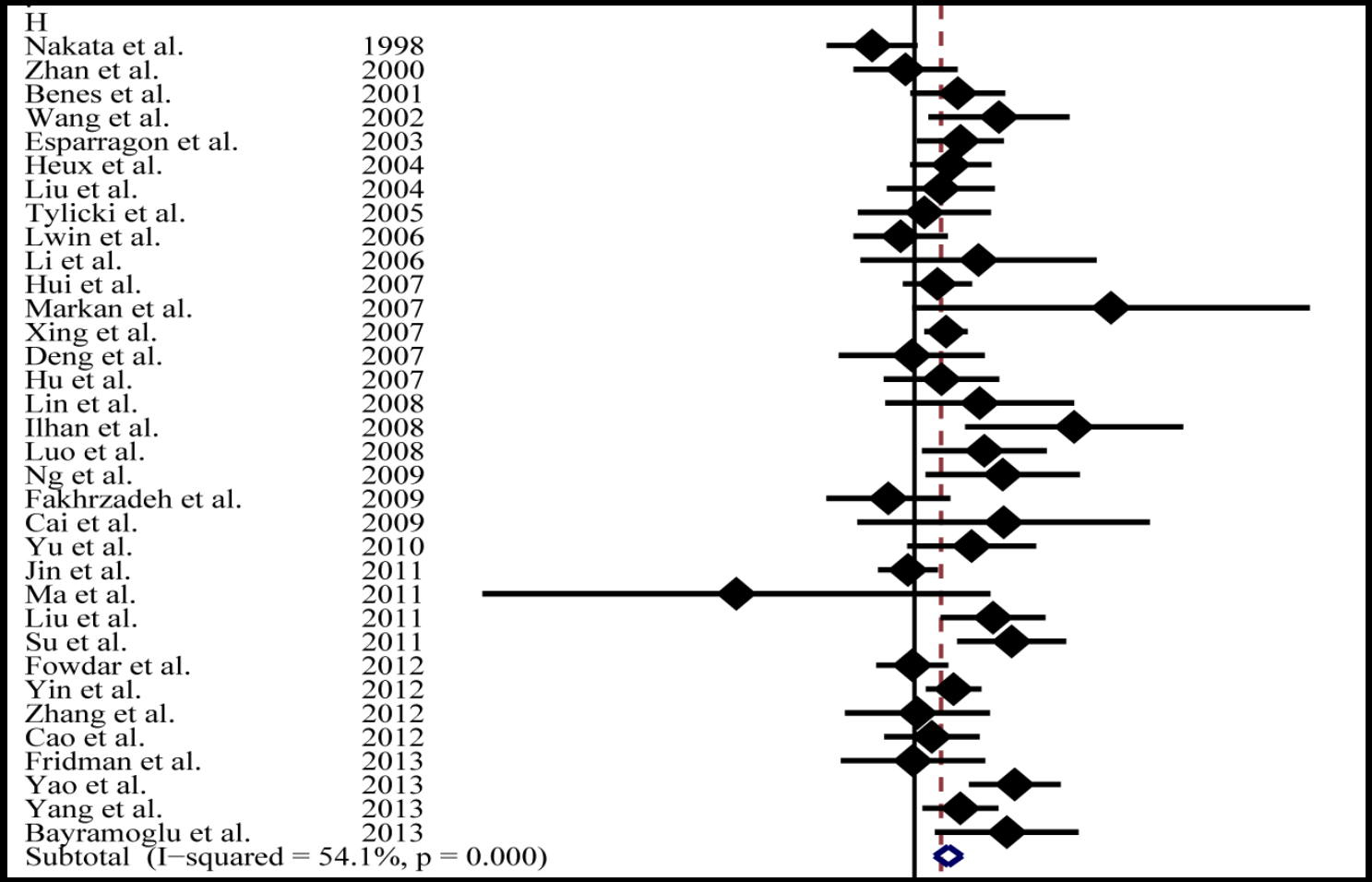
0
1970
1980
1990
2000
2010
2018

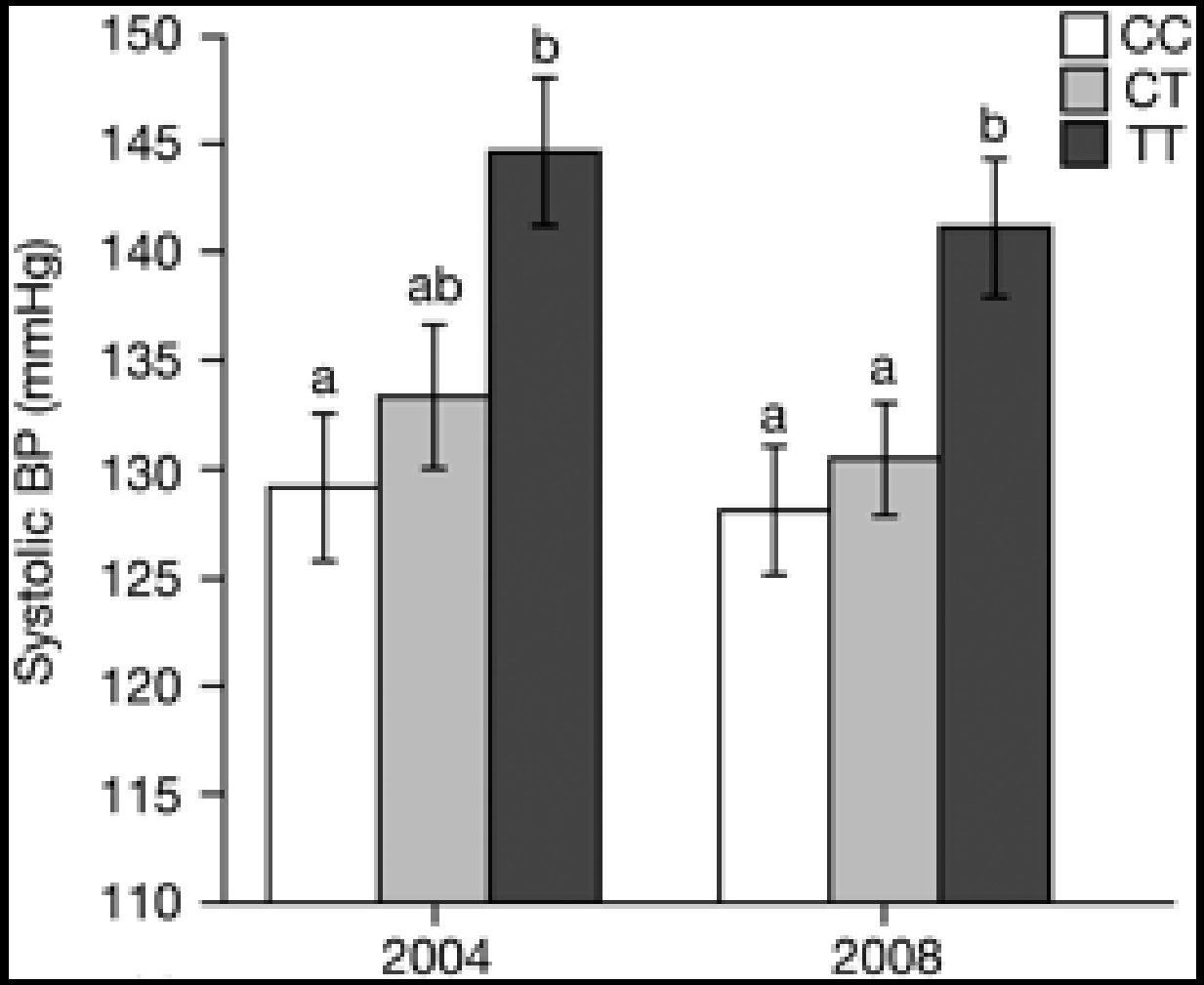
MTHFR 677TT and hypertension



Odds ratio: **1.63** (1.34 – 1.98)

Yang B *et al*, Plos One 2014

MTHFR 677TT and hypertension

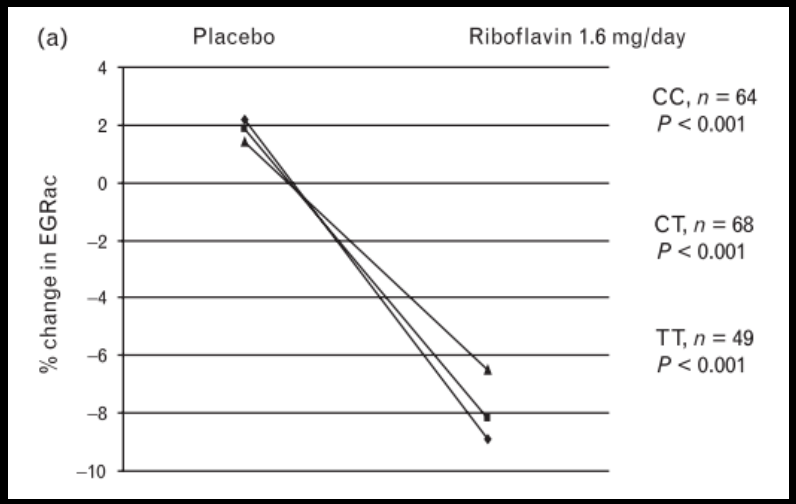


Horigan G *et al*. J Hypertens 2010, Wilson C *et al*. Am J Clin Nutr 2012

Riboflavin, MTHFR 677TT and blood pressure

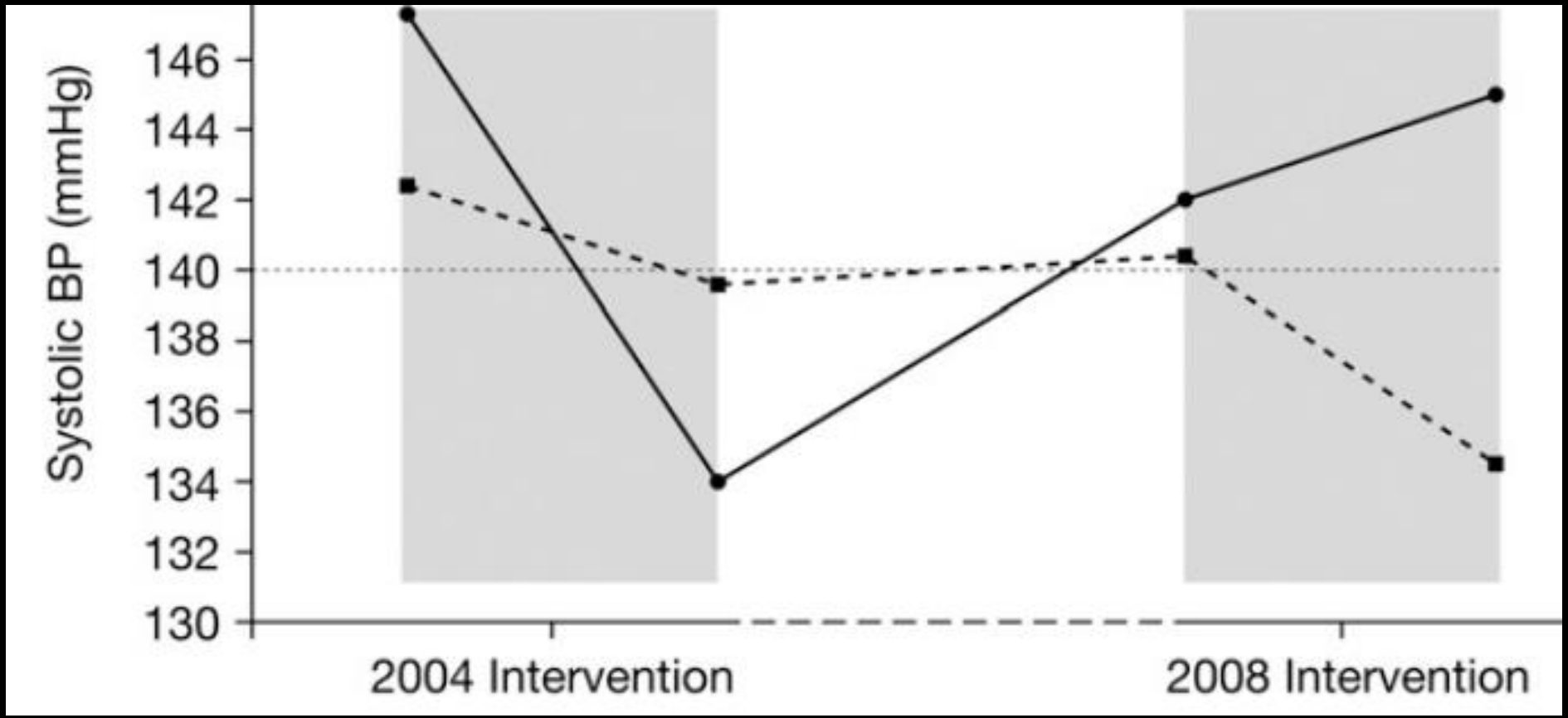
Response to blood pressure medication	
CC	64 %
CT	59 %
TT	37 %

Systolic blood pressure response to riboflavin (1.6mg)	
CC	-0.9 mmHg
CT	-0.8 mmHg
TT	**-13.4 mmHg**



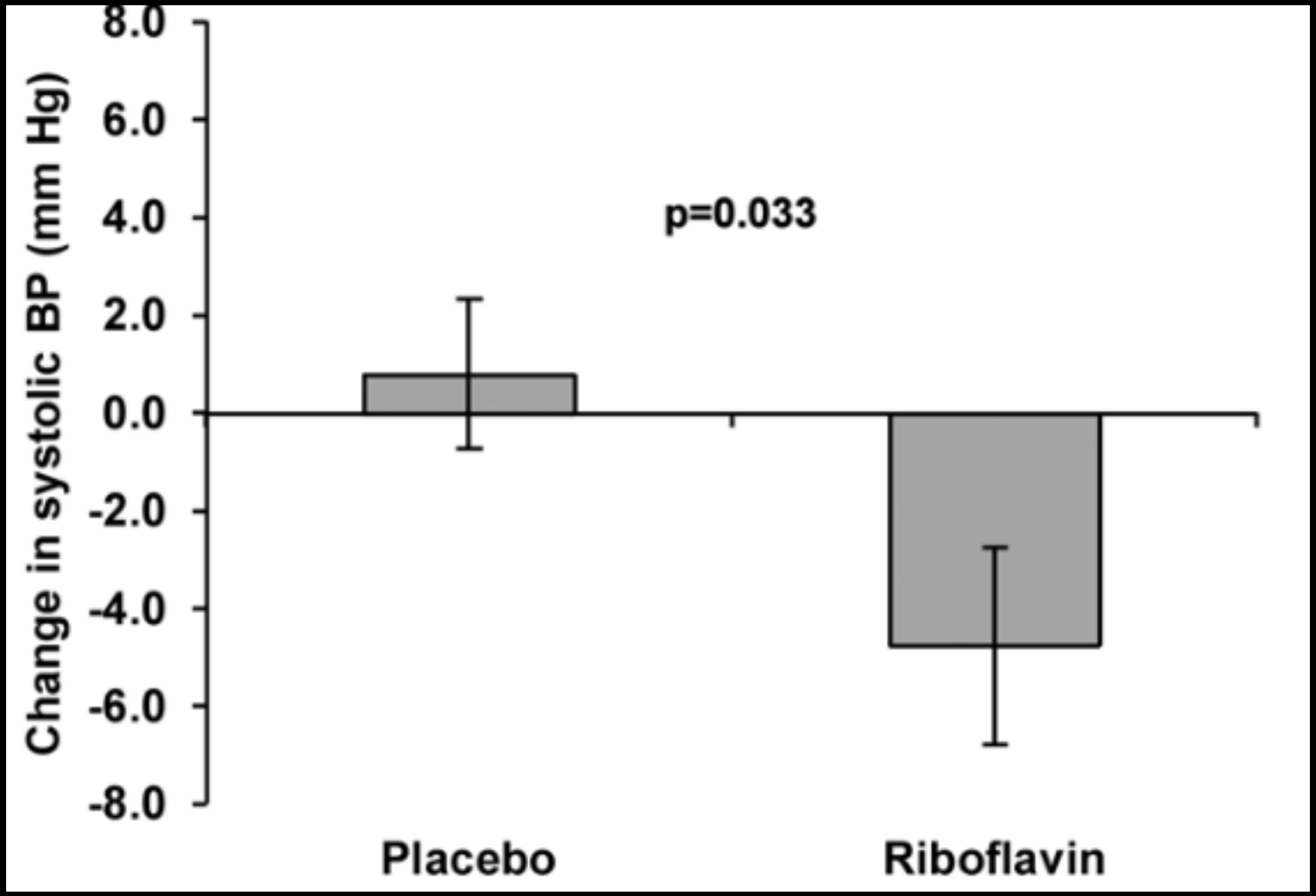
Horigan GJ *et al.* Hypertens 2010

Riboflavin, MTHFR 677TT and blood pressure



Horigan GJ *et al,* Hypertens 2010, Wilson C *et al*. Am J Clin Nutr 2012

Riboflavin, MTHFR 677TT and blood pressure



Wilson, C *et al*. Hypertens 2013

MTHFR and precision nutrition

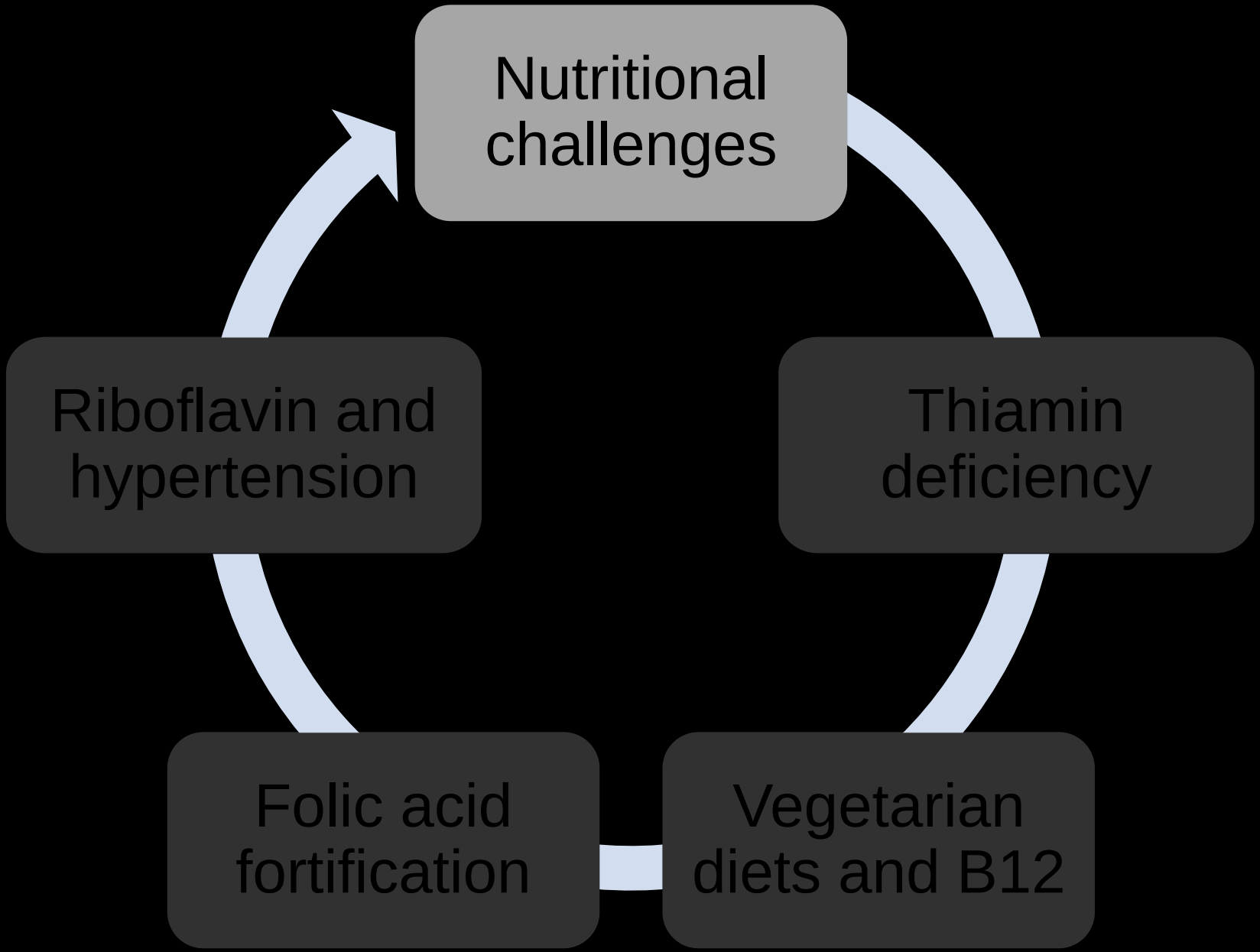
TT prevalence: ~10%

High prevalence of hypertension, especially combined with poor riboflavin status

Poor response to antihypertensives, but good response to low-dose riboflavin supplements

Targeted or population-wide strategy?

McNulty, H *et al*. Mol Asp Med 2017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- Nutritional challenges are not limited to deficiency
- Staple foods are crucial for B-vitamin status
- Consider dietary trends
- Prevention strategies must consider potential harms
- Gene-nutrient interactions are knocking on our door