Dairy foods and blood pressure: a review of current evidence

Mary Ward RD PhD

Nutrition & Health: What's New?

Dairy Council for Northern Ireland

Dairy foods and blood pressure

- **Hypertension:** definitions / cut-offs; size of the problem and risk factors

- **Nutrition and blood pressure:**
  - Dairy foods / whole diets
  - B-vitamins (riboflavin): a targeted approach

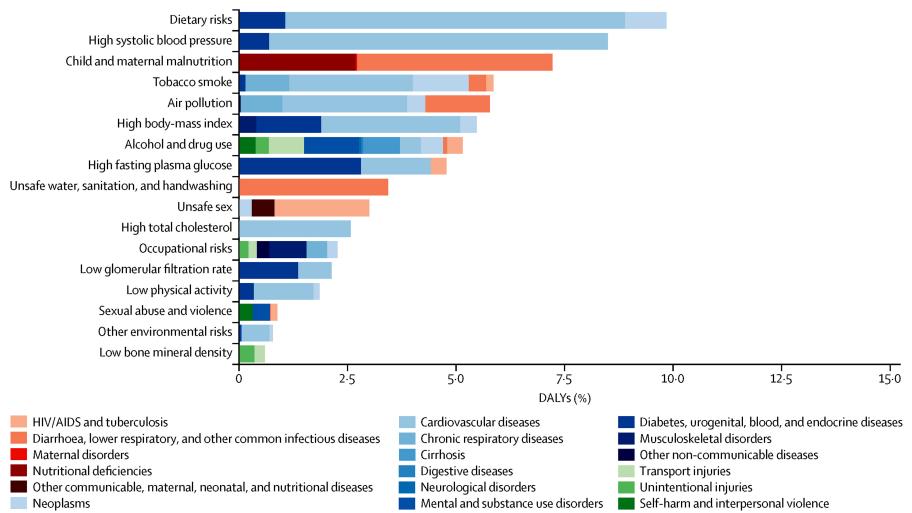- **Take-home messages**

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Hypertension

Systolic blood pressure (BP) of ≥140mmHg and/or
Diastolic BP ≥90mmHg[1]

- Primary risk factor for CVD, especially stroke, vascular dementia, chronic kidney disease
- Leading cause of preventable, premature death
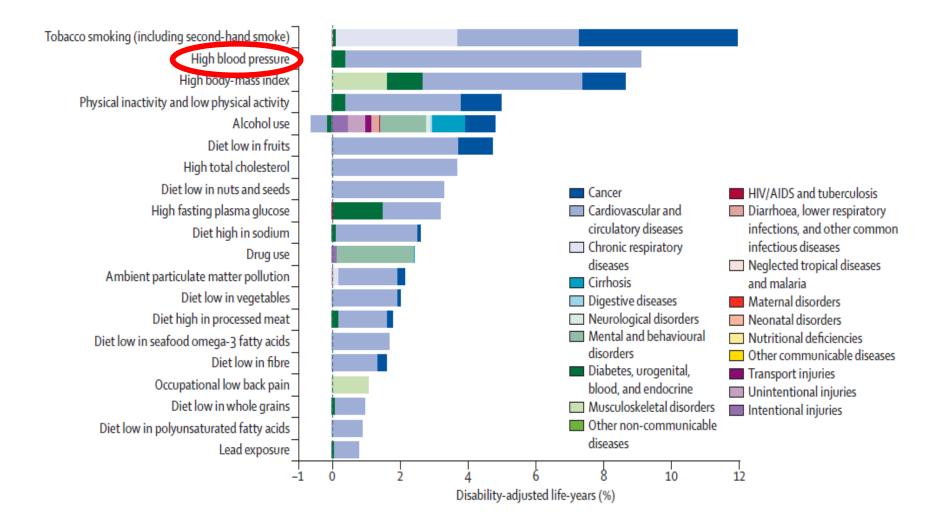- Worldwide - 1.13 billion affected[2]
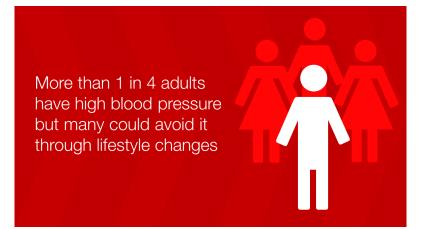
1: NICE 2016
2: WHO 2016

Global Burden of Disease

Global Burden of Disease: England

Hypertension treatment in the UK (PHE 2015)

More than 1 in 4 adults have high blood pressure but many could avoid it through lifestyle changes

Of every **10** people with high blood pressure:

4 are undiagnosed

2 are on treatment but their blood pressure isn't controlled

4 are on treatment and their blood pressure is controlled

- **Significant variation** – 30% more with hypertension in most-deprived areas versus least

- **Control rates – UK out-performed abroad** - % adults with hypertension controlled:
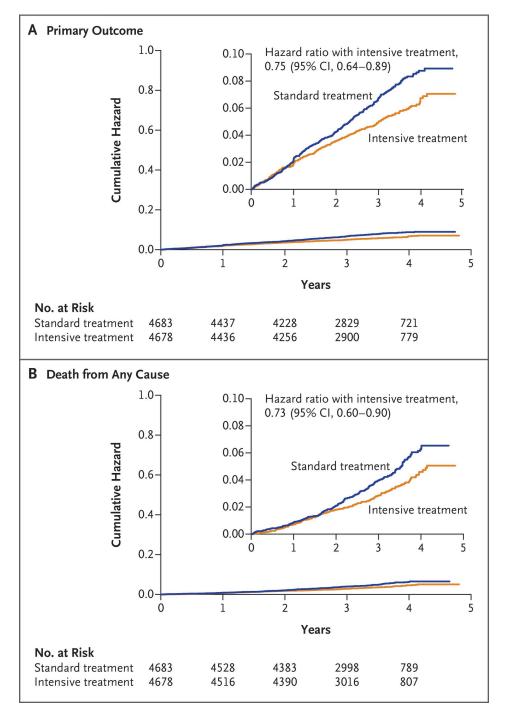
England	37%	USA	57%	Canada	66%

A Randomized Trial of Intensive versus Standard Blood-Pressure Control

The SPRINT Research Group*

A Primary Outcome

Hazard ratio with intensive treatment, 0.75 (95% CI, 0.64–0.89)

No. at Risk					
Standard treatment	4683	4437	4228	2829	721
Intensive treatment	4678	4436	4256	2900	779

B Death from Any Cause

Hazard ratio with intensive treatment, 0.73 (95% CI, 0.60–0.90)

No. at Risk					
Standard treatment	4683	4528	4383	2998	789
Intensive treatment	4678	4516	4390	3016	807

Categories of BP in Adults*

BP Category	SBP		DBP
Normal	<120 mm Hg	and	<80 mm Hg
Elevated	120–129 mm Hg	and	<80 mm Hg
Hypertension			
Stage 1	130–139 mm Hg	or	80–89 mm Hg
Stage 2	≥140 mm Hg	or	≥90 mm Hg

*Individuals with SBP and DBP in 2 categories should be designated to the higher BP category.
BP indicates blood pressure (based on an average of ≥2 careful readings obtained on ≥2 occasions, as detailed in DBP, diastolic blood pressure; and SBP systolic blood pressure.
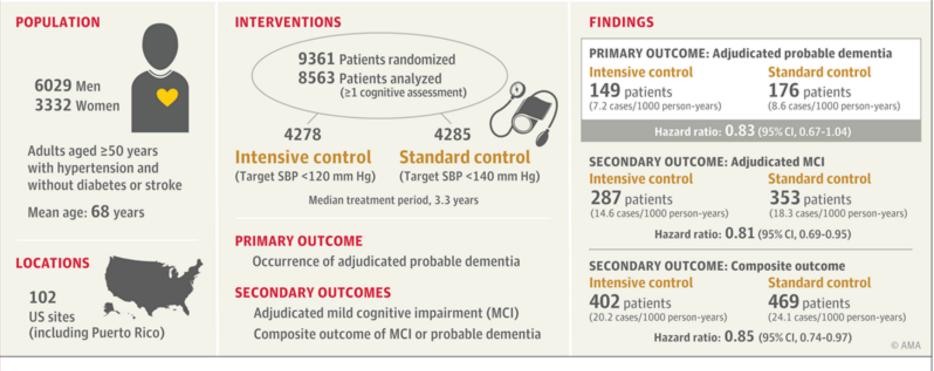
Search NICE... 🔍

Hypertension in adults: diagnosis and management

In development [GID-NG10054]
Expected publication date: 21 August 2019
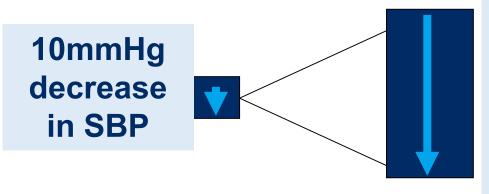Register as a stakeholder

JAMA Network

QUESTION Does intensive blood pressure control compared with standard control reduce the occurrence of dementia?

CONCLUSION This randomized clinical trial of adults with hypertension found that intensive systolic blood pressure (SBP) control (target <120 mm Hg) did not significantly reduce the risk of probable dementia.

POPULATION

6029 Men
3332 Women

Adults aged ≥50 years with hypertension and without diabetes or stroke

Mean age: **68** years

LOCATIONS

102
US sites
(including Puerto Rico)

INTERVENTIONS

9361 Patients randomized
8563 Patients analyzed
(≥1 cognitive assessment)

4278
Intensive control
(Target SBP <120 mm Hg)

4285
Standard control
(Target SBP <140 mm Hg)

Median treatment period, 3.3 years

PRIMARY OUTCOME

Occurrence of adjudicated probable dementia

SECONDARY OUTCOMES

Adjudicated mild cognitive impairment (MCI)

Composite outcome of MCI or probable dementia

FINDINGS

PRIMARY OUTCOME: Adjudicated probable dementia

Intensive control	Standard control
149 patients	**176** patients
(7.2 cases/1000 person-years)	(8.6 cases/1000 person-years)

Hazard ratio: **0.83** (95% CI, 0.67-1.04)

SECONDARY OUTCOME: Adjudicated MCI

Intensive control	Standard control
287 patients	**353** patients
(14.6 cases/1000 person-years)	(18.3 cases/1000 person-years)

Hazard ratio: **0.81** (95% CI, 0.69-0.95)

SECONDARY OUTCOME: Composite outcome

Intensive control	Standard control
402 patients	**469** patients
(20.2 cases/1000 person-years)	(24.1 cases/1000 person-years)

Hazard ratio: **0.85** (95% CI, 0.74-0.97)

© AMA

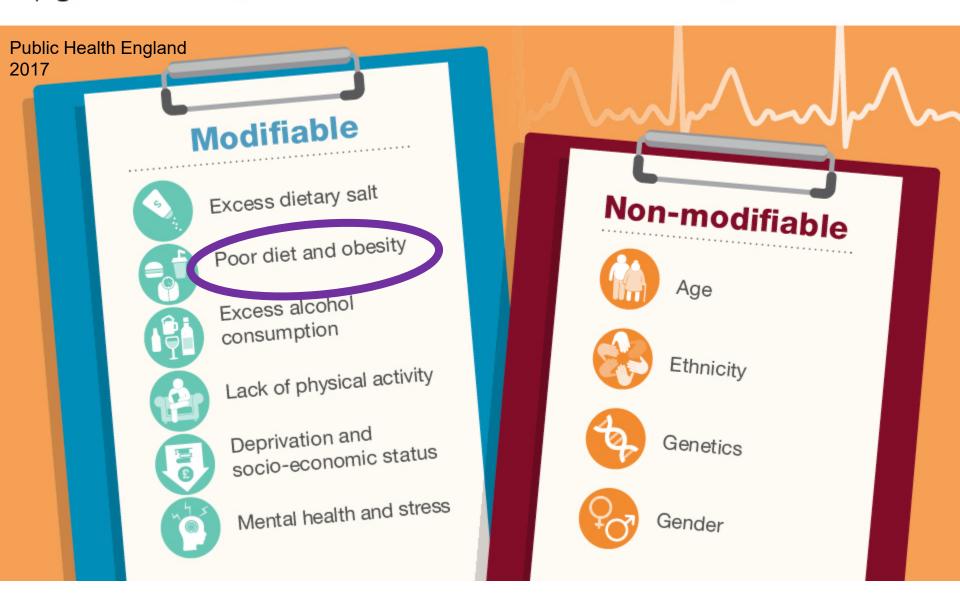# Impact of BP reduction

10mmHg decrease in SBP

- 17% reduction in CHD
- 27% reduction for stroke
- 28% reduction for heart failure
- **13% reduction in all-cause mortality**

- 123 studies with 613815 participants
- 1966-2015: All RCTs of BP lowering were included that had a minimum of 1,000 patient-years of follow-up in each treatment arm;
- No exclusion on basis of co-morbidities or anti-hypertensive use;
- Benefits associated with lowering BP to <130mmHg

Ettehad et al, Lancet **2016; 387: 957–67**

Modifiable

- Excess dietary salt
- Poor diet and obesity
- Excess alcohol consumption
- Lack of physical activity
- Deprivation and socio-economic status
- Mental health and stress

Non-modifiable

- Age
- Ethnicity
- Genetics
- Gender

Lifestyle factors targeted to reduce BP

Lifestyle factor	SBP decrease (mmHg)
Weight loss (per 10 kg)	5 - 20
Physical activity	4 - 9
Sodium reduction	2 - 8
Limit alcohol	2 - 4

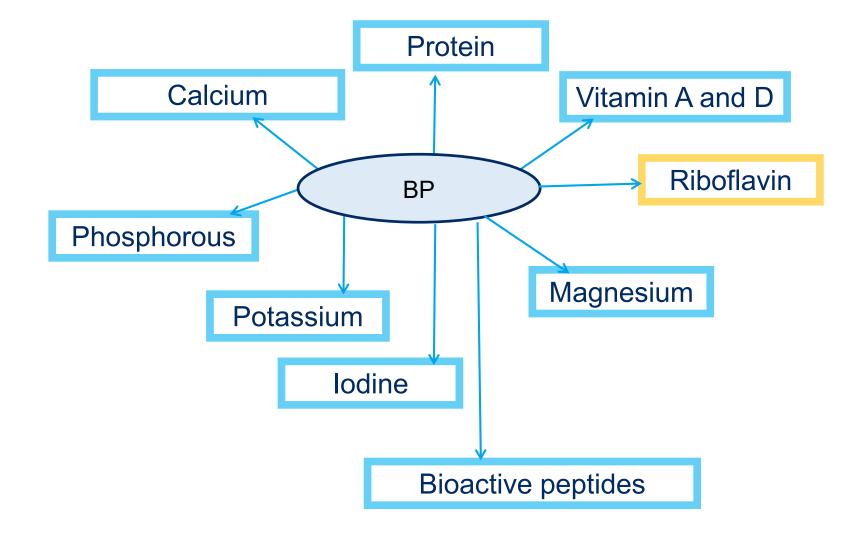Modified from Chobanian *et al.* 2003 JNC 7 report
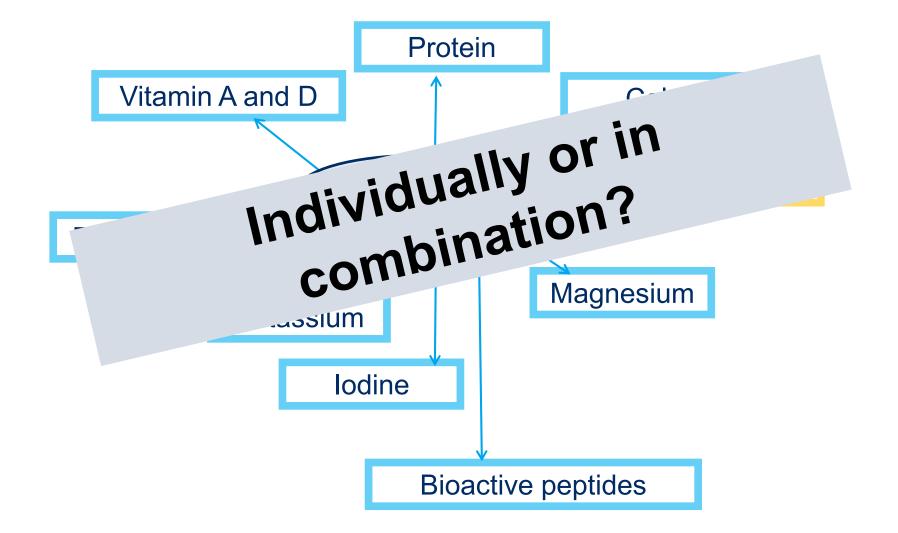
Dairy foods and blood pressure

- **Hypertension:** update on definitions, size of the problem and risk factors for hypertension

- **Nutrition and blood pressure**

  - Dairy foods and whole diets
  - B-vitamins: a targeted approach

- **Take-home messages**

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Nutrients supplied by dairy rich foods with the potential to influence Blood Pressure

Nutrients supplied by dairy rich foods with the potential to influence Blood Pressure

Protein

Vitamin A and D

Ca[...]

Magnesium

[...]ssium

Iodine

Bioactive peptides

Individually or in combination?

Meta-analysis of total dairy intake and total CHD:
prospective cohort studies of dairy intake and CVD

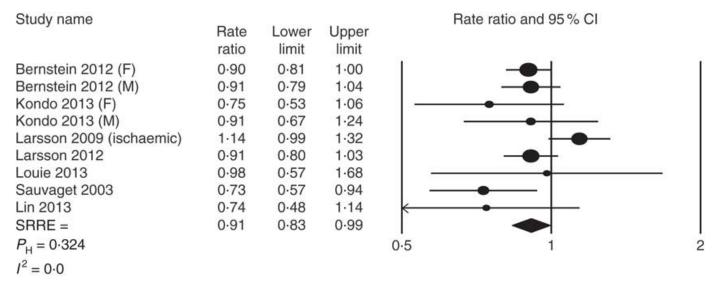| Study name	Rate ratio	Lower limit	Upper limit
Bernstein 2010	0·99	0·91	1·08
Bostick 1999	0·94	0·66	1·34
Haring 2014	1·04	0·84	1·29
Kondo 2013 (F)	0·60	0·36	1·00
Kondo 2013 (M)	1·49	0·91	2·45
Louie 2013	0·71	0·51	0·99
Patterson 2013	0·77	0·63	0·95
Soedamah-Muthu 2012	0·91	0·68	1·22
SRRE =	0·91	0·80	1·04

$P_H = 0.038$

$I^2 = 52.8$

Fig. 3 Meta-analysis of total dairy intake and total CHD (high *v.* low intake analysis). SRRE, summary relative risk estimate. Individual studies required to report a composite total dairy variable and a compositive total CHD variable. F, female; M, male.

Alexander, D et al (2016). Dairy consumption and CVD: A systematic review and meta-analysis. *British Journal of Nutrition, 115*(4), 737-750.

Meta-analysis of total dairy intake and total stroke:
prospective cohort studies of dairy intake and CVD

Study name	Rate ratio	Lower limit	Upper limit	Rate ratio and 95% CI
Bernstein 2012 (F)	0·90	0·81	1·00	
Bernstein 2012 (M)	0·91	0·79	1·04	
Kondo 2013 (F)	0·75	0·53	1·06	
Kondo 2013 (M)	0·91	0·67	1·24	
Larsson 2009 (ischaemic)	1·14	0·99	1·32	
Larsson 2012	0·91	0·80	1·03	
Louie 2013	0·98	0·57	1·68	
Sauvaget 2003	0·73	0·57	0·94	
Lin 2013	0·74	0·48	1·14	
SRRE =	0·91	0·83	0·99	

$P_H = 0.324$

$I^2 = 0.0$

Removal of Larsson 2009 in a sensitivity analyses resulted in and SRRE of 0·88 (95% CI 0·83, −0·94) with no heterogeneity ($P_H = 0.73$, $I^2 = 0.00$)

Fig. 4 Meta-analysis of total dairy intake and total stroke. SRRE, summary relative risk estimate. Individual studies required to report a composite total dairy variable and a compositive total stroke variable. F, female; M, male.

Alexander, D et al (2016). Dairy consumption and CVD: A systematic review and meta-analysis. *British Journal of Nutrition, 115*(4), 737-750.

Association of dairy intake with cardiovascular disease and mortality in 21 countries from five continents (PURE): a prospective cohort study

Mahshid Dehghan, PhD • Andrew Mente, PhD • Sumathy Rangarajan, MSc • Patrick Sheridan, MSc

Prof Viswanathan Mohan, MD • Romaina Iqbal, PhD • et al. Show all authors •

Check for updates

Health

Dairy food in moderation 'may protect the heart'

Three small portions of dairy a day may actually protect against heart disease and stroke

Sarah Boseley
Health editor
Tue 11 Sep 2018
23.30 BST

2885

WHY WHOLE-FAT MILK MAY BE BETTER FOR YOU THAN YOU THINK, ACCORDING TO EXPERTS

A few portions of milk a day may keep the doctor away, researchers suggest

NHS

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Home › Behind the Headlines › Food and diet

Moderate dairy consumption may help heart health

Wednesday September 12 2018

Page contents

- Where did the story come from?
- What kind of research was this?
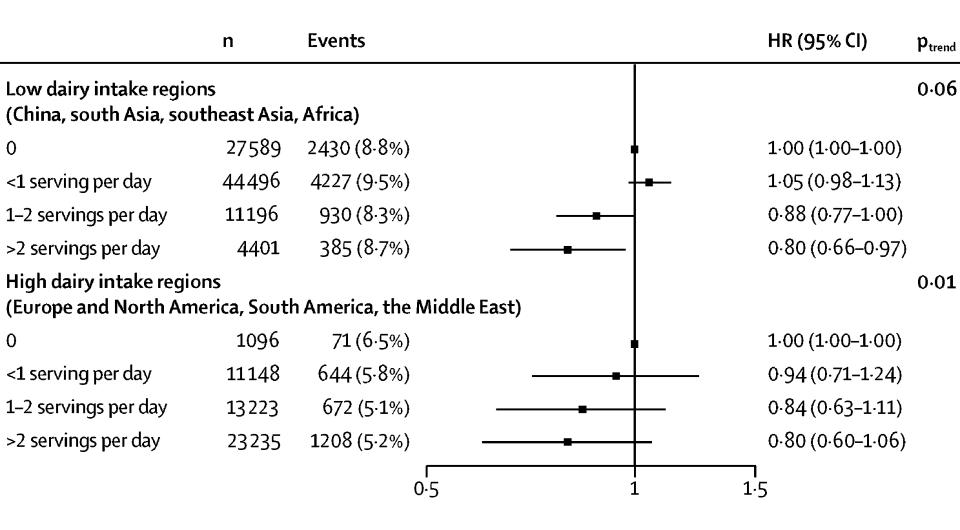- What did the research involve?
- What were the basic results?

"Drinking three glasses of whole milk a day can help you live longer," reports the Sun.

An international team of researchers looked at dairy consumption among more than 136,000 people in 21 countries worldwide.

They found people who had more than 2 servings of dairy products a day were 16% less likely to die or have a heart attack or stroke during an average of 9 years of follow-up.

https://www.nhs.uk/news/food-and-diet/moderate-dairy-consumption-may-help-heart-health/

PURE: Association between total dietary intake with risk of composite outcome and CVD in low and high dairy intake regions

	n	Events		HR (95% CI)	p_{trend}
Low dairy intake regions					0·06
(China, south Asia, southeast Asia, Africa)					
0	27589	2430 (8·8%)		1·00 (1·00–1·00)	
<1 serving per day	44496	4227 (9·5%)		1·05 (0·98–1·13)	
1–2 servings per day	11196	930 (8·3%)		0·88 (0·77–1·00)	
>2 servings per day	4401	385 (8·7%)		0·80 (0·66–0·97)	
High dairy intake regions					0·01
(Europe and North America, South America, the Middle East)					
0	1096	71 (6·5%)		1·00 (1·00–1·00)	
<1 serving per day	11148	644 (5·8%)		0·94 (0·71–1·24)	
1–2 servings per day	13223	672 (5·1%)		0·84 (0·63–1·11)	
>2 servings per day	23235	1208 (5·2%)		0·80 (0·60–1·06)	

0·5   1   1·5

Dehghan et al, Lancet. 2018 Nov 24;392(10161):2288-2297

PURE (Prospective Urban Rural Epidemiology)

- Investigated the associations between dairy food consumption (milk, yoghurt, cheese) and the risk of major cardiovascular disease events

- <u>Dietary intakes</u> of dairy products were recorded using country-specific validated <u>food frequency questionnaires</u>.

- Included data from **136,000 adults (aged 35-70yrs) from 21 countries on 5 continents,** followed for a median of **9.1 years**

- **Dairy food** consumption (>2 servings/day vs 0) **was associated with a 22% lower risk of cardiovascular disease and a 34% lower risk of stroke;**

- **Milk** consumption (>1 serving/day vs 0) **was associated with an 18% lower risk of cardiovascular disease;**

- **Yogurt** consumption (>1 serving/day vs 0) **was associated with a 10% lower risk of cardiovascular disease.**

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PURE (Prospective Urban Rural Epidemiology)

- Investigated the associations between dairy food consumption (milk, yoghurt, cheese) and the risk of major cardiovascular disease events

- <u>Dietary intakes</u> of dairy products were ~~~~ specific validated food f~~~~

- ~~~~

- ~~~~ ~~~~ and a 34% lower ~~~~

- M~~~~ consumption (>1 serving/day vs 0) **was associated with an 18% lower risk of cardiovascular disease;**

- **Yogurt** consumption (>1 serving/day vs 0) **was associated with a 10% lower risk of cardiovascular disease.**

> **Interpretation**
> Dairy consumption was associated with lower risk of mortality and major cardiovascular disease events in a diverse multinational cohort.

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Whole Diet Approaches: DASH

The NEW ENGLAND JOURNAL of MEDICINE

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ORIGINAL ARTICLE

A Clinical Trial of the Effects of Dietary Patterns on Blood Pressure

Lawrence J. Appel, M.D., M.P.H., Thomas J. Moore, M.D., Eva Obarzanek, Ph.D., William M. Vollmer, Ph.D., Laura P. Svetkey, M.D., M.H.S., Frank M. Sacks, M.D., George A. Bray, M.D., Thomas M. Vogt, M.D., M.P.H., Jeffrey A. Cutler, M.D., Marlene M. Windhauser, Ph.D., R.D., Pao-Hwa Lin, Ph.D., Njeri Karanja, Ph.D., Denise Simons-Morton, M.D., Ph.D., Marjorie McCullough, M.S., R.D., Janis Swain, M.S., R.D., Priscilla Steele, M.S., R.D., Marguerite A. Evans, M.S., R.D., Edgar R. Miller, M.D., Ph.D., and David W. Harsha, Ph.D. for the DASH Collaborative Research Group

Share:

Abstract   Article   References   Citing Articles (1772)   Letters

Mean Systolic and Diastolic Blood Pressures at Baseline and during each Intervention week, according to Diet, for 379 Subjects with Complete Sets of Weekly Blood-Pressure Measurements.

Appel LJ et al. N Engl J Med 1997;336:1117-1124.

DASH: Dietary approaches to stop Hypertension

6-8 servings of whole grains
4-5 servings of vegetables
4-5 servings of fruits
2-3 servings of fat-free or low-fat dairy
Up to 6 servings of lean meat, poultry, fish
4-5 servings per week of nuts, seeds, legumes
2-3 servings of fats and oils
Up to 5 servings per week of sweets

Systematic Review with Meta-Analysis

Effects of the Dietary Approach to Stop Hyperte
cardiovascular risk factors: a systematic review

Mario Siervo[1]*, Jose Lara[1], Shakir Chowdhury[1], Ammar Ashor[1,2]

[1]Human Nutrition Research Centre, Institute of Cellular Medicine, Newcastle
Newcastle upon Tyne NE4 5PL, UK
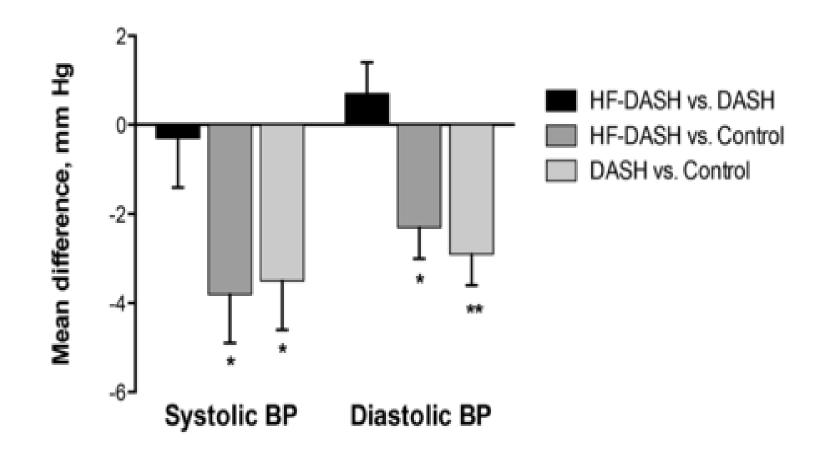[2]College of Medicine, University of Al-Mustansiriyab, Baghdad, Iraq

Forest plots of randomised clinical trials investigating the effects of DASH diet interventions on
(a) Systolic BP
(b) Diastolic BP

FIGURE 2 Differences between diets in systolic and diastolic BP. *P < 0.017, **P < 0.001. Values are means ± SEs, ...

OXFORD
UNIVERSITY PRESS

INTERMAP: INTERnational study on MAcro/micronutrients and blood pressure (INTERMAP)

- **2694 participants** aged **40-59 years** from the **UK and the USA.**
- Eight BP, four 24-h dietary recalls and two 24-h urine samples were collected during four visits.
- 195 g/1000 kcal greater low-fat dairy intake was associated with a **lower SBP -2.31 mmHg and DBP -2.27 mmHg.**
- Low-fat dairy consumption was associated with lower BP, especially among participants with low ACR.
- Dairy-rich nutrients including **phosphoru**s and **calcium** may have contributed to the beneficial associations with BP
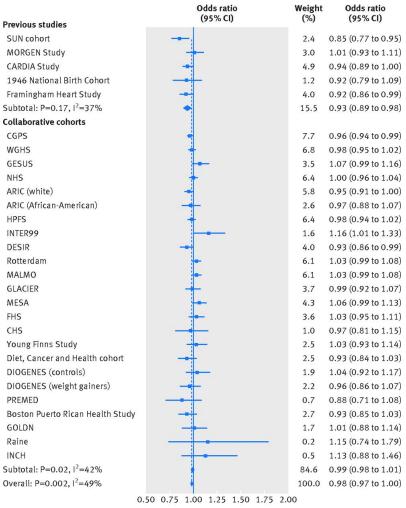
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A systematic review and meta-analysis of elevated blood pressure and consumption of dairy foods
Ralston et al, *J Human Hypertension*, 2012, 26, 3-13

Relative Risk, 95% CI
Generic inverse variance method, random effects model

Study	Weight	RR (95% CI)
Total Dairy Foods		
Alonso 2005[9][b]	2.58%	0.75 (0.44-1.27) [d]
Steffen 2005[16]	6.70%	0.82 (0.59-1.14) [d]
Engberink 2009b[12]	20.62%	0.84 (0.70-1.01) [d]
Wang 2008[18]	59.79%	0.86 (0.79-0.94) [e]
Engberink 2009a[24]	10.31%	1.11 (0.85-1.44) [f]
Total[3]	100.00%	0.87 (0.81-0.94)
Heterogeneity: $I^2 = 0\%$		
Test for overall effect: Z = 3.74, P = 0.0002		
Low Fat Dairy Foods		
Alonso 2005[9][b]	2.41%	0.46 (0.25-0.84) [d]
Engberink 2009a[24]	12.65%	0.82 (0.64-1.06) [f]
Engberink 2009b[12]	23.49%	0.84 (0.70-1.01) [d]
Wang 2008[18]	61.45%	0.89 (0.81-0.98) [e]
Total[3]	100.00%	0.84 (0.74-0.95)
Heterogeneity: $I^2 = 38\%$		
Test for overall effect: Z = 2.68, P = 0.007		
High Fat Dairy Foods		
Engberink 2009b[12]	16.92%	0.93 (0.76-1.13) [d]
Wang 2008[18]	70.15%	0.96 (0.89-1.03) [e]
Engberink 2009a[24]	10.45%	1.19 (0.92-1.54) [f]
Alonso 2005[9][b]	2.49%	1.37 (0.77-2.42) [d]
Total[3]	100.00%	1.00 (0.89-1.11)
Heterogeneity: $I^2 = 27\%$		
Test for overall effect: Z = 0.06, P = 0.95		
Cheese		
Wang 2008[18]	26.19%	0.87 (0.70-1.08) [e]
Engberink 2009b[12]	32.54%	0.98 (0.81-1.18) [d]
Steffen 2005[b]	23.02%	1.07 (0.85-1.35) [d]
Engberink 2009a[24]	18.25%	1.17 (0.90-1.52) [f]
Total[3]	100.00%	1.00 (0.89-1.12)
Heterogeneity: $I^2 = 11\%$		
Test for overall effect: Z = 0.01, P = 0.99		
Fluid Dairy Foods		
Engberink 2009b[12][b]	12.0%	0.83 (0.68-1.01) [d]
Steffen 2005[16]	9.8%	0.87 (0.70-1.08) [d]
Steffen 2005[16]	15.4%	0.88 (0.75-1.04) [d]
Wang 2008[18]	36.0%	0.93 (0.86-1.01) [e]
Wang 2008[18]	19.7%	0.97 (0.85-1.11) [e]
Engberink 2009a[24]	7.1%	1.09 (0.84-1.42) [f]
Total[3]	100.00%	0.92 (0.87-0.98)
Heterogeneity: $I^2 = 0\%$		
Test for overall effect: Z = 2.76, P = 0.006		

0.1　0.2　0.5　1　2　5　10

Fig 2 Association of baseline dairy consumption (serving/day) with relative risk of hypertension in observational cohort studies.

	Odds ratio (95% CI)	Weight (%)	Odds ratio (95% CI)
Previous studies			
SUN cohort		2.4	0.85 (0.77 to 0.95)
MORGEN Study		3.0	1.01 (0.93 to 1.11)
CARDIA Study		4.9	0.94 (0.89 to 1.00)
1946 National Birth Cohort		1.2	0.92 (0.79 to 1.09)
Framingham Heart Study		4.0	0.92 (0.86 to 0.99)
Subtotal: P=0.17, I²=37%		15.5	0.93 (0.89 to 0.98)
Collaborative cohorts			
CGPS		7.7	0.96 (0.94 to 0.99)
WGHS		6.8	0.98 (0.95 to 1.02)
GESUS		3.5	1.07 (0.99 to 1.16)
NHS		6.4	1.00 (0.96 to 1.04)
ARIC (white)		5.8	0.95 (0.91 to 1.00)
ARIC (African-American)		2.6	0.97 (0.88 to 1.07)
HPFS		6.4	0.98 (0.94 to 1.02)
INTER99		1.6	1.16 (1.01 to 1.33)
DESIR		4.0	0.93 (0.86 to 0.99)
Rotterdam		6.1	1.03 (0.99 to 1.08)
MALMO		6.1	1.03 (0.99 to 1.08)
GLACIER		3.7	0.99 (0.92 to 1.07)
MESA		4.3	1.06 (0.99 to 1.13)
FHS		3.6	1.03 (0.95 to 1.11)
CHS		1.0	0.97 (0.81 to 1.15)
Young Finns Study		2.5	1.03 (0.93 to 1.14)
Diet, Cancer and Health cohort		2.5	0.93 (0.84 to 1.03)
DIOGENES (controls)		1.9	1.04 (0.92 to 1.17)
DIOGENES (weight gainers)		2.2	0.96 (0.86 to 1.07)
PREMED		0.7	0.88 (0.71 to 1.08)
Boston Puerto Rican Health Study		2.7	0.93 (0.85 to 1.03)
GOLDN		1.7	1.01 (0.88 to 1.14)
Raine		0.2	1.15 (0.74 to 1.79)
INCH		0.5	1.13 (0.88 to 1.46)
Subtotal: P=0.02, I²=42%		84.6	0.99 (0.98 to 1.01)
Overall: P=0.002, I²=49%		100.0	0.98 (0.97 to 1.00)

0.50 0.75 1.00 1.25 1.50 1.75 2.00

Relative risk of hypertension

Ming Ding et al. BMJ 2017;356:bmj.j1000

the**bmj**

Fig 1 Association of baseline dairy consumption (serving/day) with systolic blood pressure in observational cohort studies.

	Weight (%)	Effect size (95% CI)
Previous studies		
SU.VI.MAX cohort	1.0	0.06 (-0.77 to 0.96)
The Hoorn Study	2.8	0.27 (-0.22 to 0.76)
STANISLAS (men)	0.2	-0.68 (-2.56 to 1.20)
STANISLAS (women)	0.3	0.81 (-0.83 to 2.45)
1946 birth cohort	0	-1.89 (-15.21 to 11.40)
Caerphilly Prospective Study	0.01	-10.4 (-19.37 to -1.40)
Nutrition and Health of Aging Population in China	0.2	-2.82 (-4.99 to -0.66)
Framingham Heart Study	15.6	-0.21 (-0.29 to -0.12)
Subtotal: P=0.02, I^2=57%	20.0	-0.15 (-0.67 to 0.37)
Collaborative cohorts		
CGPS	13.6	-0.28 (-0.40 to -0.16)
WGHS	12.0	-0.03 (-0.18 to 0.12)
GESUS	8.6	-0.14 (-0.36 to 0.08)
ARIC (white)	6.2	-0.22 (-0.51 to 0.07)
ARIC (African-American)	0.9	0.23 (-0.69 to 1.14)
INTER99	4.8	-0.29 (-0.62 to 0.07)
D.E.S.I.R. Study	4.2	-0.22 (-0.60 to 0.16)
Rotterdam Study	6.1	0.16 (-0.13 to 0.46)
Malmö Diet and Cancer Study	4.5	-0.06 (-0.43 to 0.30)
GLACIER	3.3	-0.03 (-0.47 to 0.42)
MESA	2.3	0.29 (-0.26 to 0.84)
Family Health Study	2.6	-0.04 (-0.55 to 0.47)
Cardiovascular Health Study	0.4	0.64 (-0.68 to 1.96)
Young Finns Study	4.4	0.17 (-0.20 to 0.54)
Diet, Cancer and Health cohort	0.8	-0.30 (-1.29 to 0.69)
DIOGENES (controls)	0.6	-0.12 (-1.22 to 0.97)
DIOGENES (weight gainers)	0.6	0.16 (-0.96 to 1.28)
PREDIMED study	0.4	0.14 (-1.35 to 1.63)
BPRHS	1.0	-0.60 (-1.48 to 0.27)
GOLDN	1.3	0.08 (-0.67 to 0.84)
Raine	1.4	-0.18 (-0.92 to 0.55)
InCHIANTI	0.2	-1.34 (-3.19 to 0.51)
Subtotal: P=0.32, I^2=11%	80.0	-0.11 (-0.20 to -0.03)
Overall: P=0.07, I^2=30%	100.0	-0.11 (-0.20 to -0.02)

Systolic blood pressure (mm Hg)

Ming Ding et al. BMJ 2017;356:bmj.j1000

the**bmj**

Does Dairy Food Intake Predict Arterial Stiffness and Blood Pressure in Men? Evidence from the Caerphilly Prospective Study
Katherine M. Livingstone, Julie A. Lovegrove, John R. Cockcroft, Peter C. Elwood, Janet E. Pickering, D. Ian Givens
(*Hypertension*. 2013;61:42-47.)

- First prospective study to investigate the association between milk and dairy product consumption and 2 measures of arterial stiffness: aortic pulse wave velocity (aPWV) and augmentation index.

- High consumption of milk, cheese, and cream associated with lower augmentation index after a 22.8-year follow-up, butter intake positively associated with aPWV.

- Few large, cohort studies have investigated dietary predictors of arterial stiffness, an established independent predictor of cardiovascular disease events and all-cause mortality.
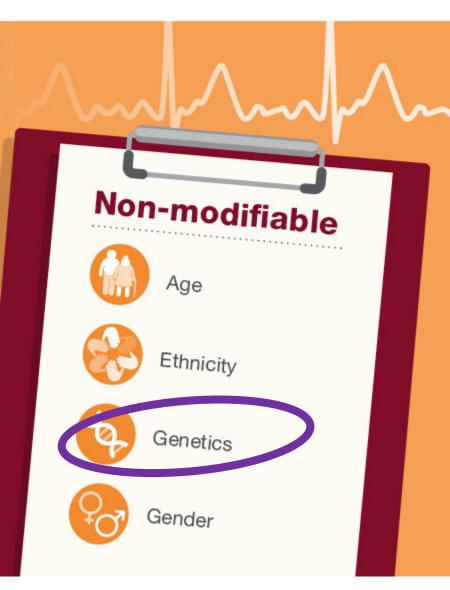
Ulster University

Modifiable

- Excess dietary salt
- Poor diet and obesity
- Excess alcohol consumption
- Lack of physical activity
- Deprivation and socio-economic status
- Mental health and stress

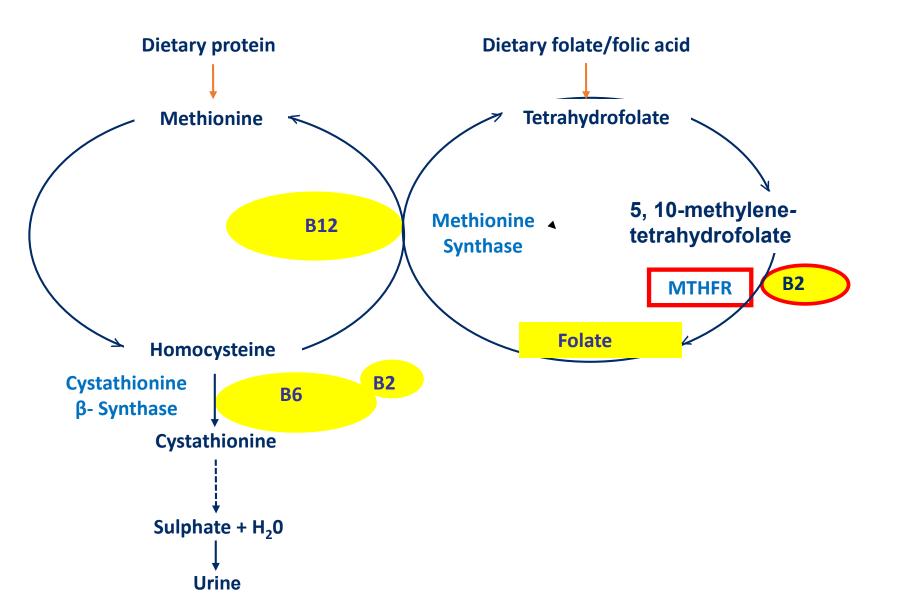## Non-modifiable

- Age
- Ethnicity
- Genetics
- Gender

Genome-wide association study identifies eight loci associated with blood pressure
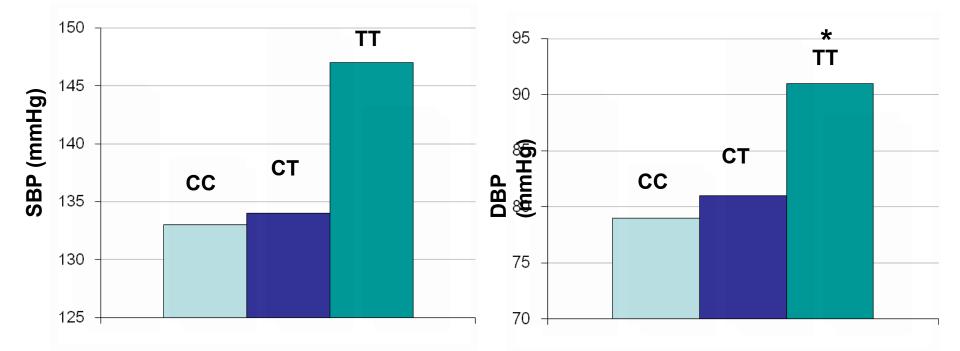
Christopher Newton-Cheh[1–3,94]*, Toby Johnson[4–6,94], Vesela Gateva[7,94], Martin D Tobin[8,94], Murielle Bochud[5], Lachlan Coin[9], Samer S Najjar[10], Jing Hua Zhao[11,12], Simon C Heath[13], Susana Eyheramendy[14,15], Konstantinos Papadakis[16], Benjamin F Voight[1,3], Laura J Scott[7], Feng Zhang[17], Martin Farrall[18,19], Toshiko Tanaka[20,21], Chris Wallace[22–24], John C Chambers[9], Kay-Tee Khaw[12,25], Peter Nilsson[26], Pim van der Harst[27], Silvia Polidoro[28], Diederick E Grobbee[29], N Charlotte Onland-Moret[29,30], Michiel L Bots[29], Louise V Wain[8], Katherine S Elliott[19], Alexander Teumer[31], Jian'an Luan[11], Gavin Lucas[32], Johanna Kuusisto[33], Paul R Burton[8], David Hadley[16], Wendy L McArdle[34], Wellcome Trust Case Control Consortium[93], Morris Brown[35], Anna Dominiczak[36], Stephen J Newhouse[22,23], Nilesh J Samani[37], John Webster[38], Eleftheria Zeggini[19,39], Jacques S Beckmann[4,40],

Newton-Cheh C, Johnson T, Gateva V *et al.* (2009) *Nat Genet* **41,** 666-676.
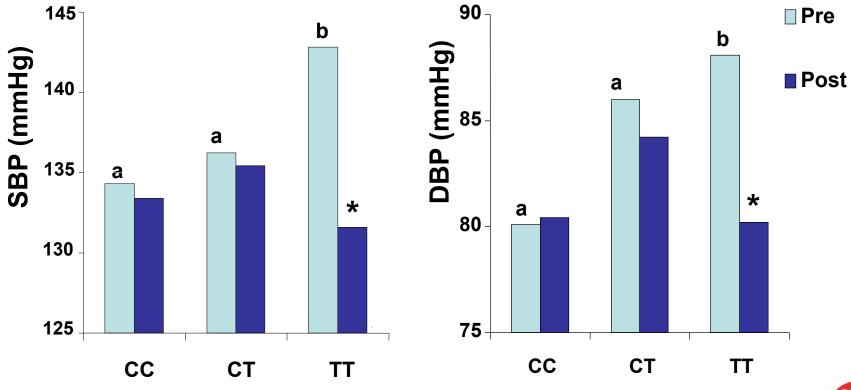
Folate Cycle

MTHFR TT genotype and Blood Pressure: early evidence

Nishio *et al.* 1996 observed a graded relationship between BP and the number of T alleles [8]

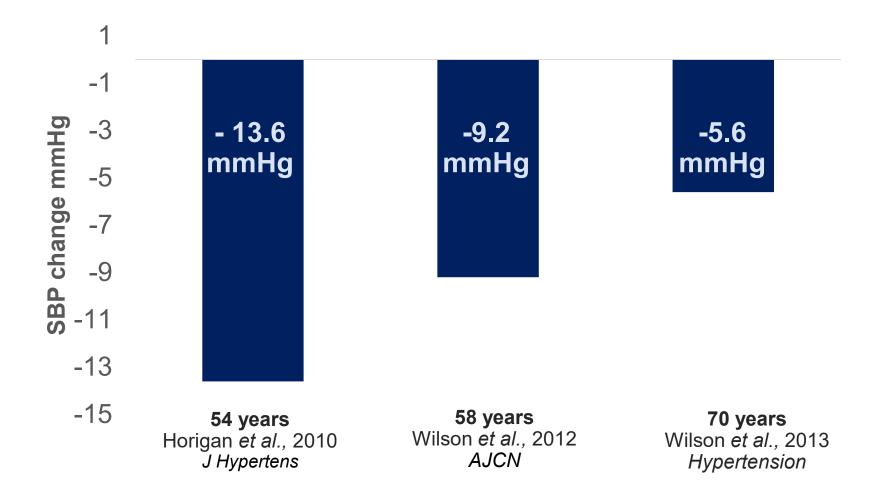Nishio *et al.* 1996 *Jpn J Hum Genet* **41**(2), 247-251.
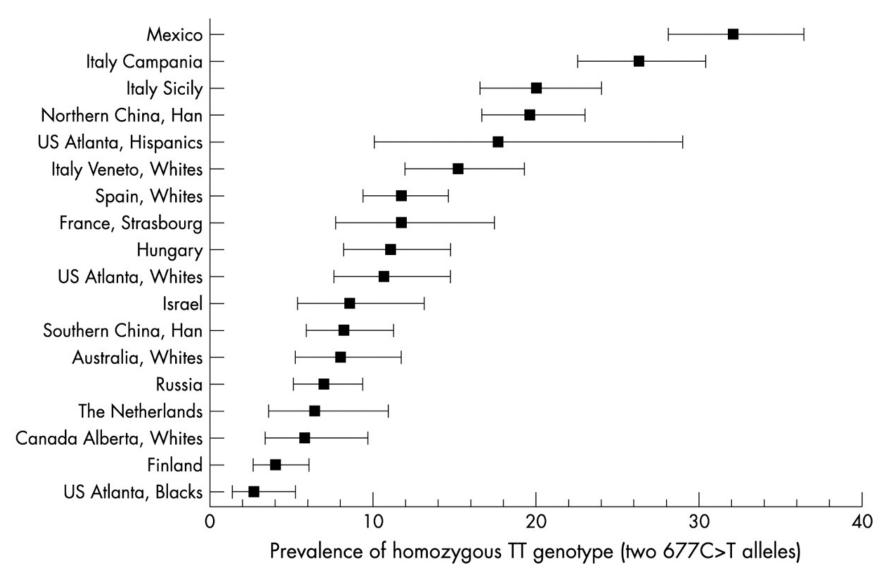
BP lowering by riboflavin in genetically at risk adults

Horigan *et al.* 2010 *Journal of Hypertension;* **28:** 478-486.

BP response to riboflavin (1.6mg/d), in TT genotype (Ulster studies)

SBP change mmHg

- 13.6 mmHg — **54 years** Horigan *et al.*, 2010 *J Hypertens*
- -9.2 mmHg — **58 years** Wilson *et al.*, 2012 *AJCN*
- -5.6 mmHg — **70 years** Wilson *et al.*, 2013 *Hypertension*

Frequency of *MTHFR* TT genotype worldwide

Prevalence of low/ deficient riboflavin intakes/ biomarker status and key dietary sources of riboflavin in a representative sample of Irish adults aged 18-90yrs
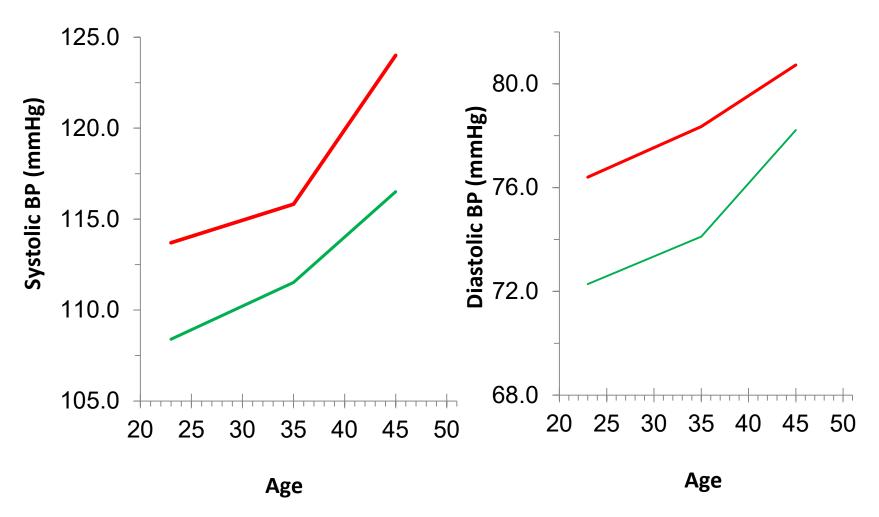
Age (years)	18-35		36-50		51-64		65+	
	Males (n 276)	Females (n 255)	Males (n 205)	Females (n 232)	Males (n 153)	Females (n 153)	Males (n 106)	Females (n 120)
Low/ deficient riboflavin intakes/ biomarker status								
% with intakes < EAR	9.9	21.2	14.5	25.6	14.9	19.6	25.1	19.4
% with EGRac > 1.3	62.9	70.1	58.3	63.8	53.1	57.8	54.5	50.6
Contribution (%) of food groups to intakes of riboflavin								
Milk	21.0	19.7	23.2	22.4	22.7	19.4	20.7	23.7
Meat & meat products	16.5	14.2	18.4	14.5	17.1	15.1	17.7	14.7
Ready-to-eat breakfast cereals	13.8	12.5	12.7	11.9	9.4	8.5	5.9	10.2
Beverages	10.2	6.7	10.0	8.7	12.3	7.7	11.3	7.8
Nutritional supplements	8.8	10.3	4.4	6.7	4.1	10.5	4.0	8.1
Bread & rolls	4.1	4.4	5.4	5.5	7.0	5.3	7.1	5.0
Other food groups	25.6	32.1	25.9	30.3	27.4	33.7	33.3	30.5

Kehoe et al. (2017), *Proc Nutr* **77**, e66.

BP in non-pregnant Irish females *by MTHFR* C677T genotype

TT versus **CC/CT** genotypes combined
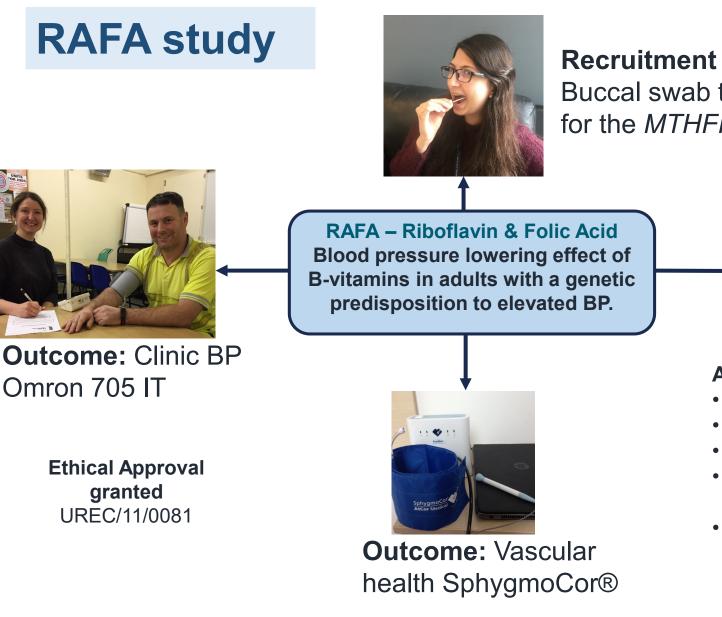*O'Sullivan et al (under review) from the Irish National Adult Nutrition Survey*

A randomised controlled trial in pregnant women with the *MTHFR* 677TT genotype, to investigate the effect of intervention with riboflavin on blood pressure during pregnancy

RAFA study

Recruitment
Buccal swab to screen for the *MTHFR* genotype

RAFA – Riboflavin & Folic Acid
Blood pressure lowering effect of B-vitamins in adults with a genetic predisposition to elevated BP.

Outcome: Clinic BP Omron 705 IT

Ethical Approval granted
UREC/11/0081

Outcome: Vascular health SphygmoCor®

Appointment:
- Clinic BP
- Central pressure
- Blood sample
- Health questionnaire
- Anthropometry

RAFA study

Ulster University

HISU @niche
Northern Ireland Centre For Food and Health

C-TRIC
Clinical Translational
Research and Innovation Centre

Coleraine

Derry / L'Derry

Belfast

NI CRF
CLINICAL RESEARCH FACILITY

Lifestyle factors targeted to reduce BP

Lifestyle factor	SBP decrease (mmHg)
Weight loss (per 10 kg)	5 - 20
Physical activity	4 - 9
Sodium reduction	2 - 8
Limit alcohol	2 – 4
DASH	2 - 13
Riboflavin	5 - 13

Modified from Chobanian *et al*. 2003 JNC 7 report

Take-home messages

- **Hypertension** is leading cause of premature preventable death

- Additional health and lifestyle strategies to decease BP are needed in light of **revised cut-offs** being proposed

- Strong evidence supports a role for **milk and dairy** in modulating BP

- The *MTHFR* **677 TT genotype** is a risk factor for hypertension <u>and</u> is associated with higher (compared with non-TT) BP across the life cycle

- **Riboflavin** offers a simple, cost-effective, **personalised approach** for the **prevention** and **treatment** of hypertension <u>specifically</u> in people with the TT genotype

- The **Clinical** and **Public Health** implications of decreasing BP are considerable

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