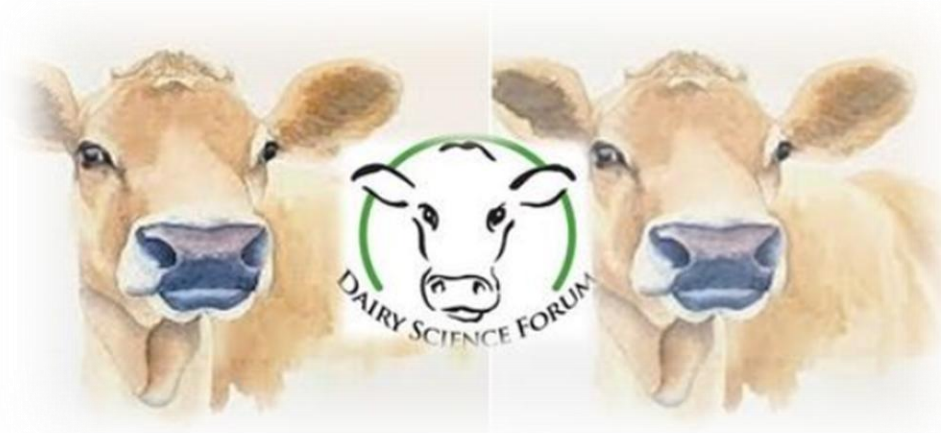
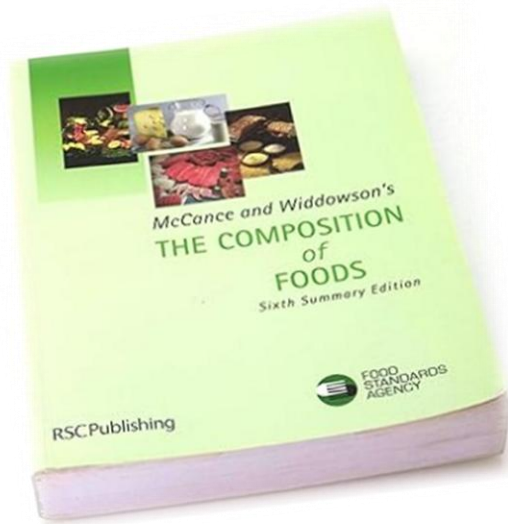


Bioactive compounds in milk/dairy foods and their value to health at key life stages: Functionality beyond nutrient supply.



10 November 2025



PREGNANCY

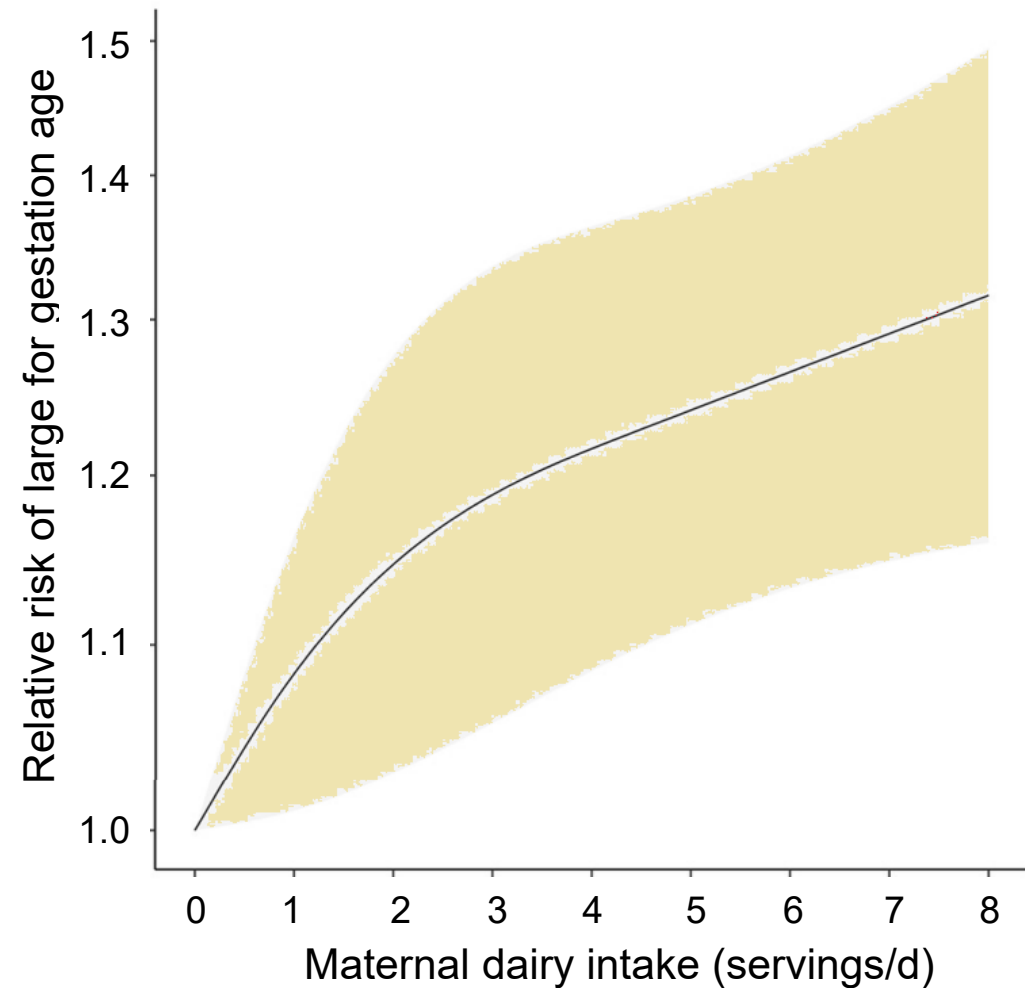
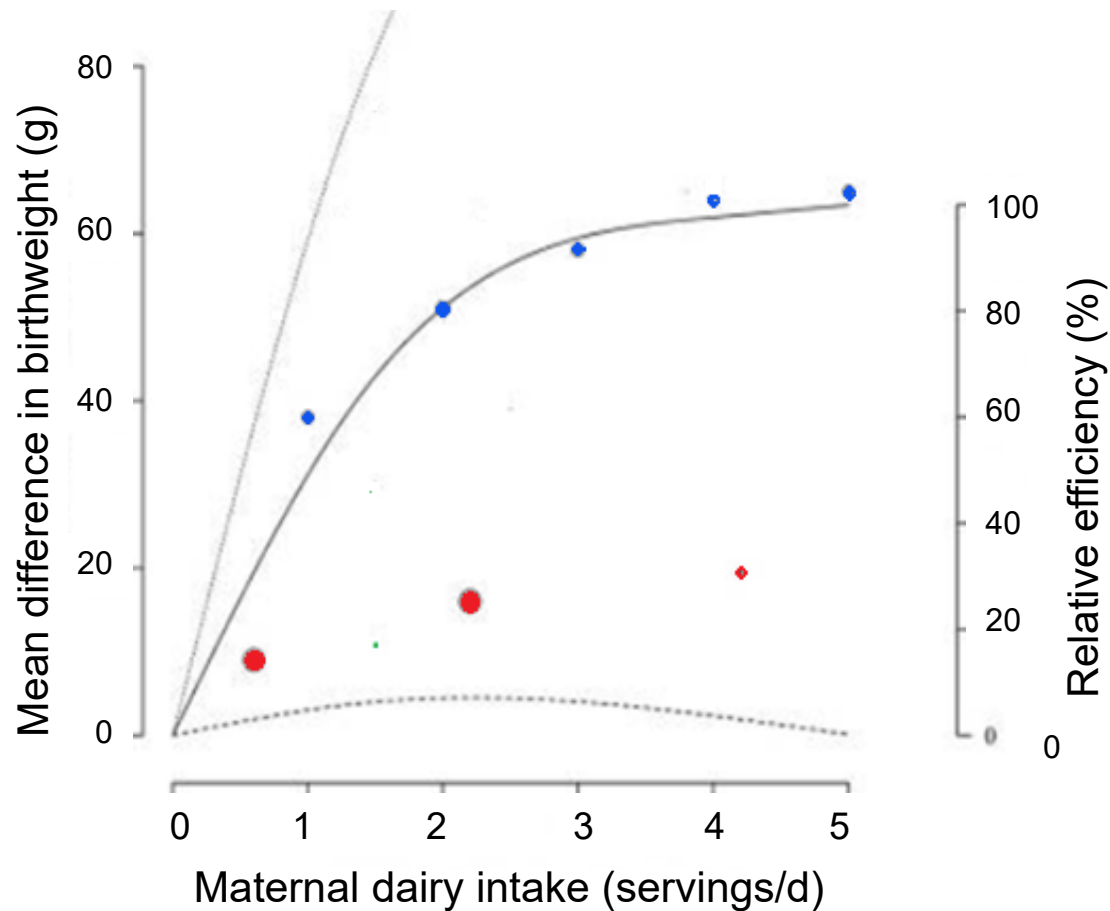


Vitamin B₁₂ Iodine



Maternal consumption of milk/dairy during pregnancy and birth anthropometrics

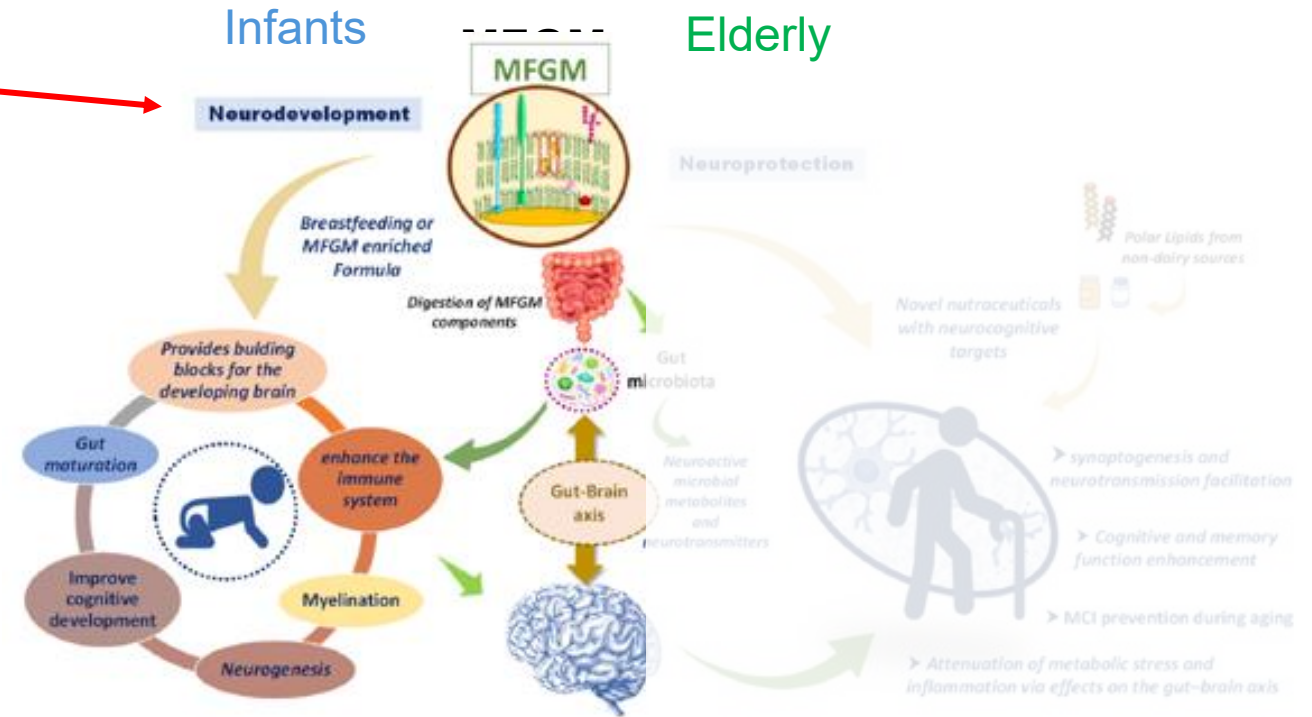
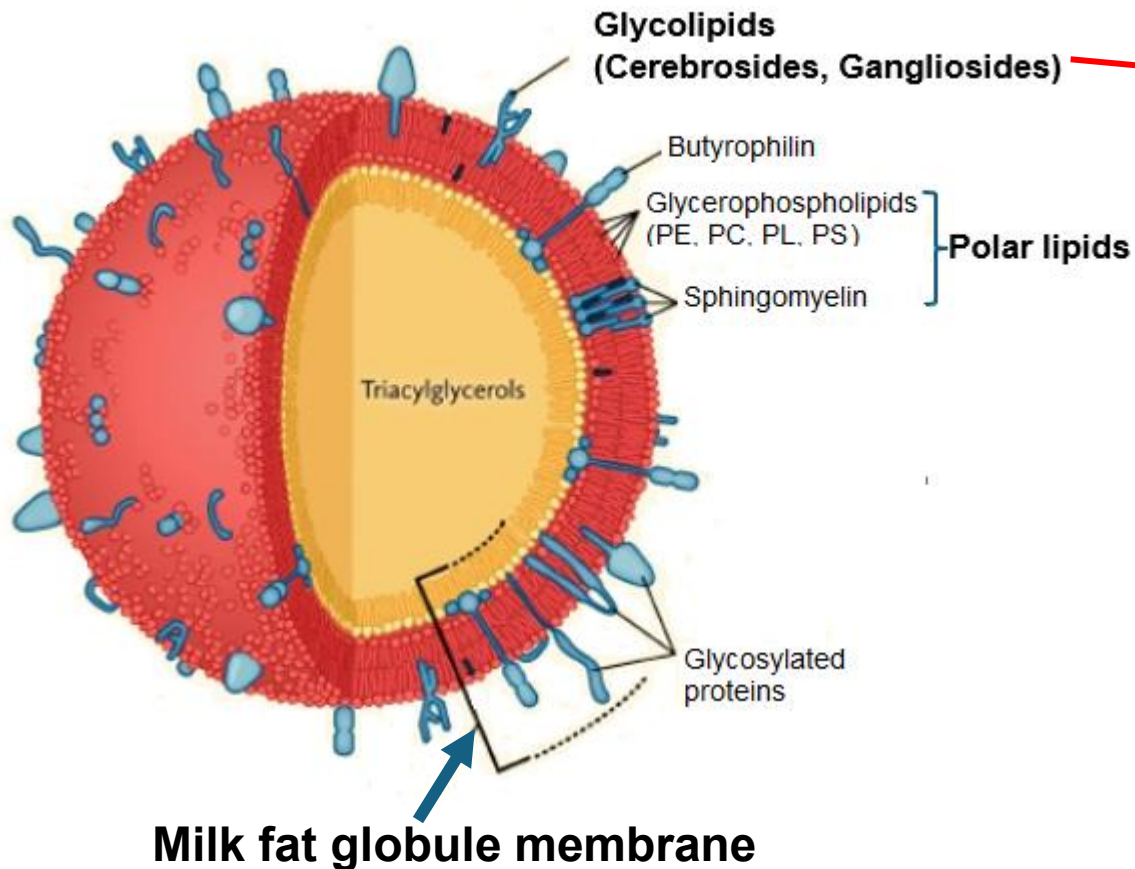
Huang et al., 2022



EARLY LIFE



Benefits of the milk fat globule membrane for infant neurodevelopment



Potential health roles of MFGM components

Luque-Uria et al., 2024

Benefits of milk fat globule membrane

XI



OPEN ACCESS

nutrients

ISSN 2072-6643

www.mdpi.com/journal/nutrients

Nutrients **2015**, *7*, 3891-3913; doi:10.3390/nu7053891

Review

The Role of Gangliosides in Neurodevelopment

Kate Palmano ¹, Angela Rowan ^{2,*}, Rozey Guillermo ³, Jian Guan ³ and Paul McJarrow ²

¹ 33 Centennial Dr, Whitianga 3510, New Zealand; E-Mail: kate.palmano@xtra.co.nz

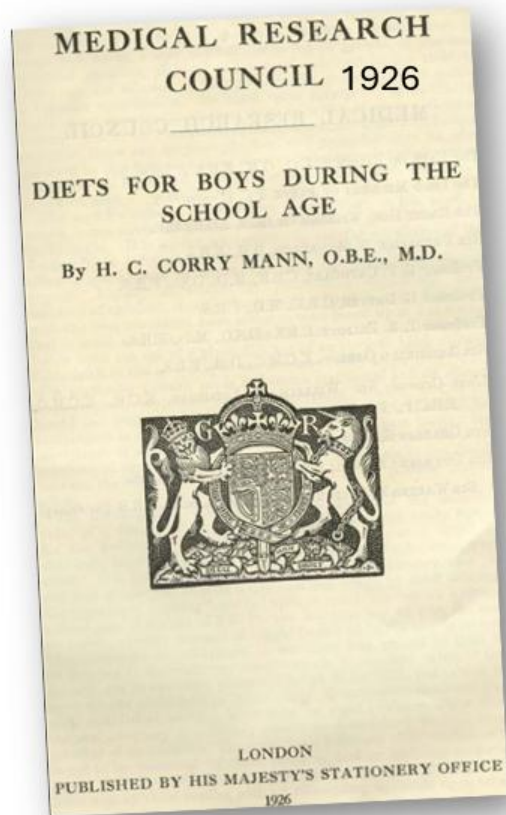
² Fonterra Co-operative Group Ltd., Private Bag 11029, Palmerston North 4442, New Zealand;
E-Mail: paul.mcjarrow@fonterra.com

³ Centre for Brain Research, Auckland University, Private Bag 92019, Auckland 1142,
New Zealand; E-Mails: r.guillermo@auckland.ac.nz (R.G.); j.guan@auckland.ac.nz (J.G.)

for children's neurodevelopment,
gastrointestinal health, and immune support



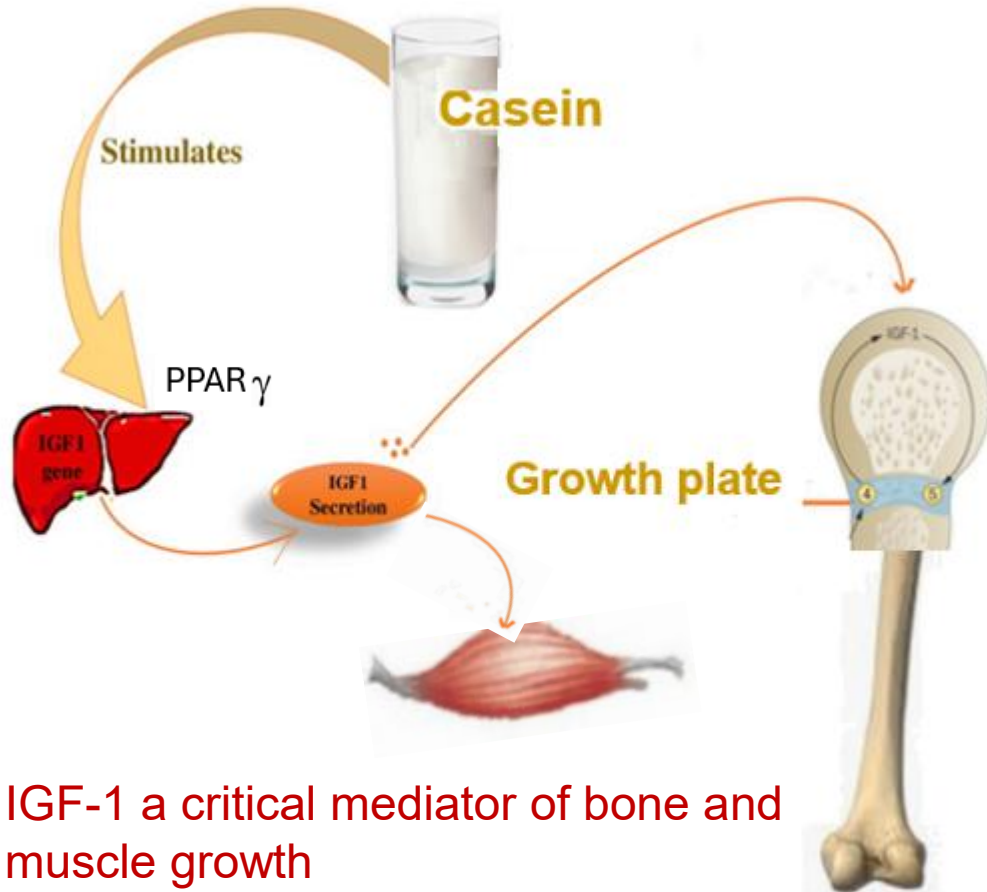
Linear growth in children: the benefits of milk protein



Stimulation of hepatic IGF-1 by casein and maybe whey protein

Hoppe et al., 2009

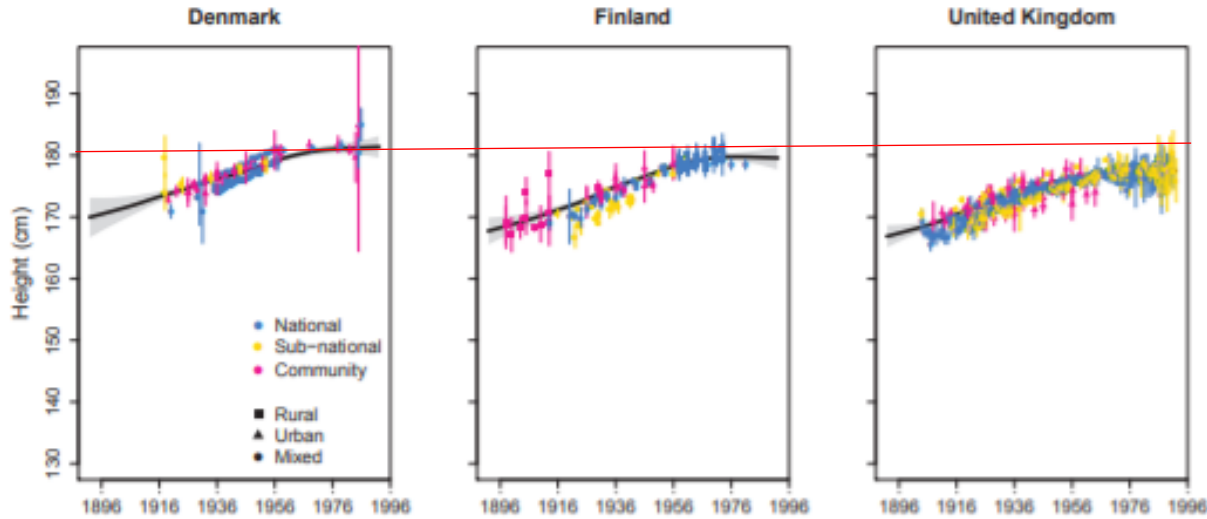
Watling et al., 2021



IGF-1 a critical mediator of bone and
muscle growth

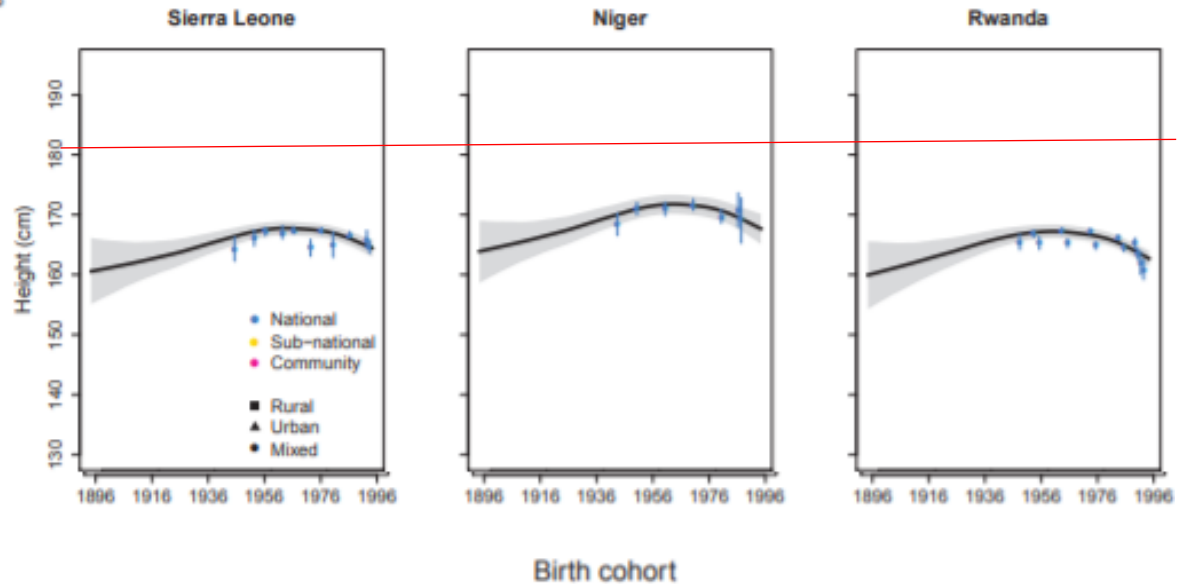


Trends in height for the male adult populations of selected countries 1896-1996



**NCD Risk Factor Collaboration.
eLife 2016;5:e13410**

Birth cohort



Birth cohort

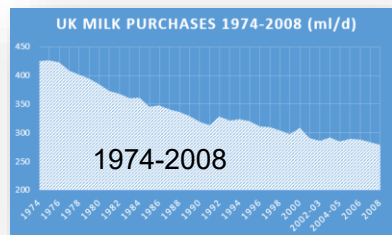
ADOLESCENCE



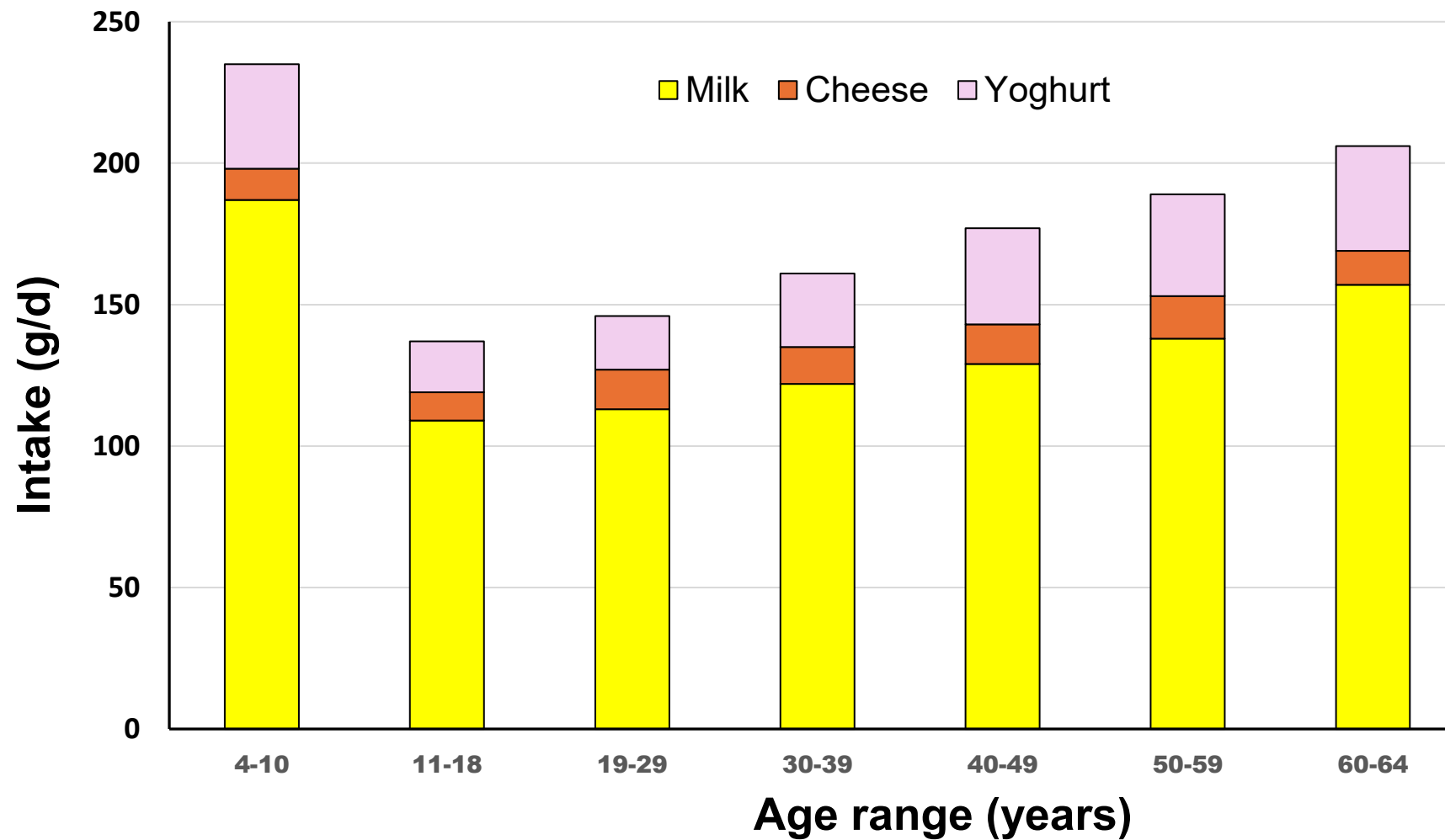
A PERIOD OF LOST MICRONUTRIENTS



Dairy food intake in UK females

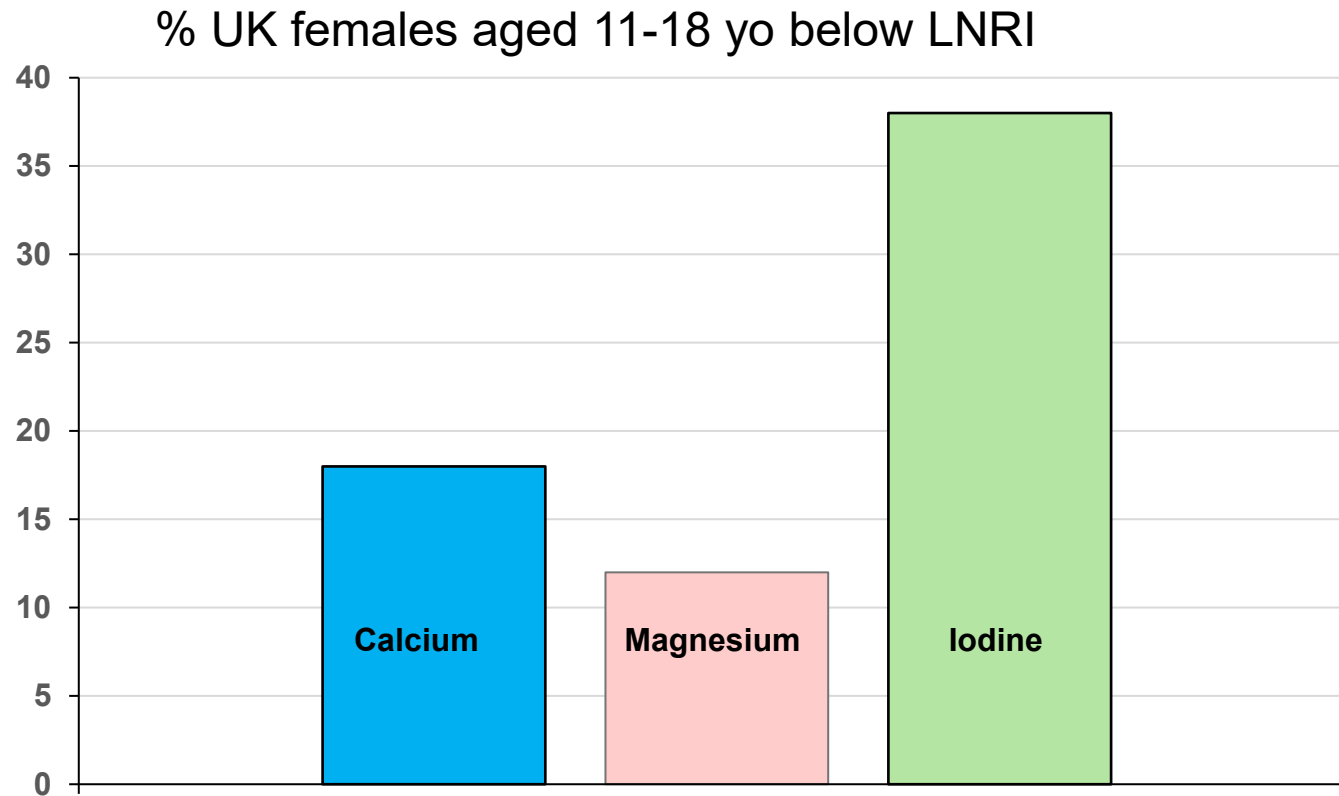


NDNS 2014, Y1-4 combined



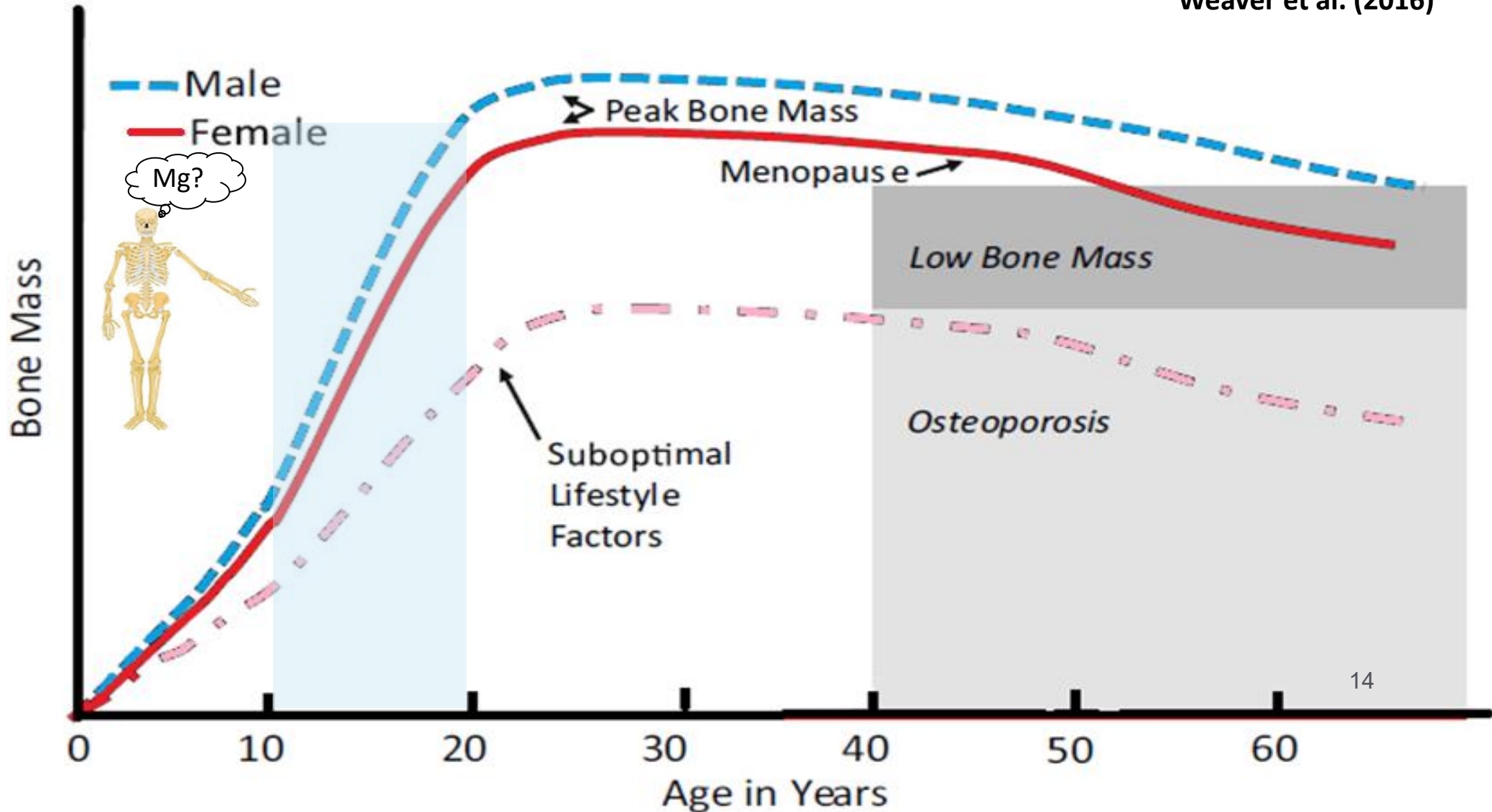
Sub-optimal micronutrient intake of UK female adolescents

National Diet and Nutrition Survey
Rolling programme 2019-2023

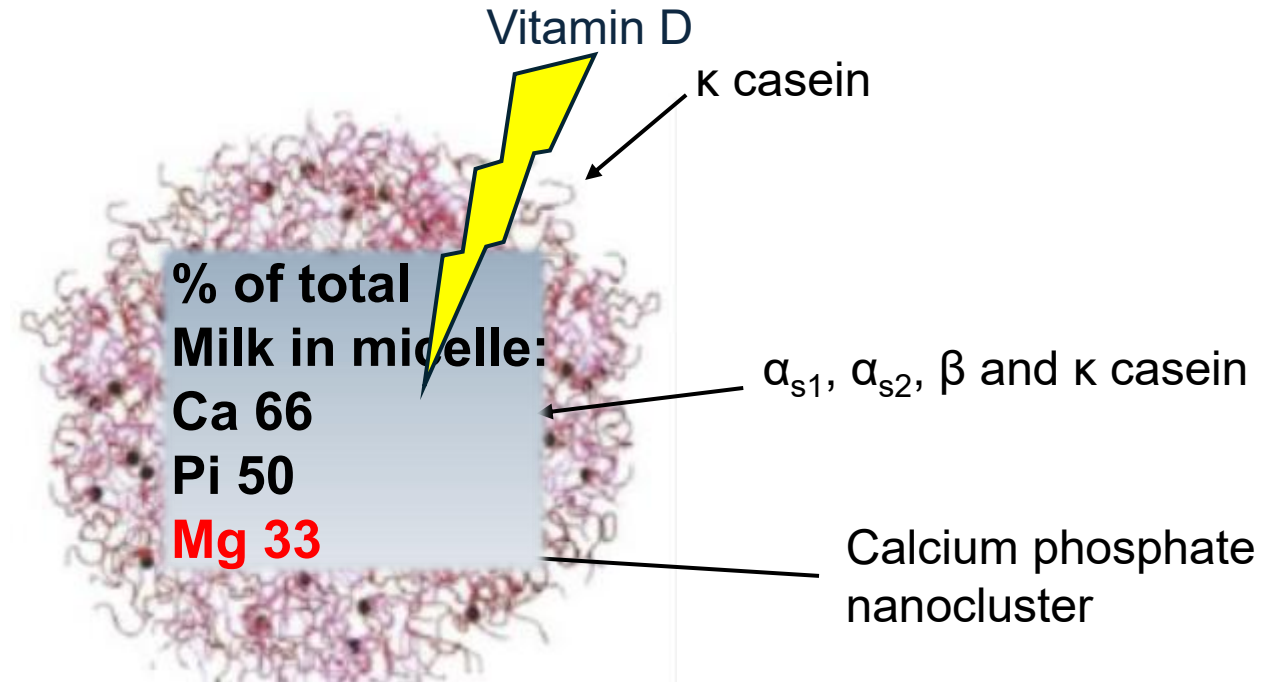
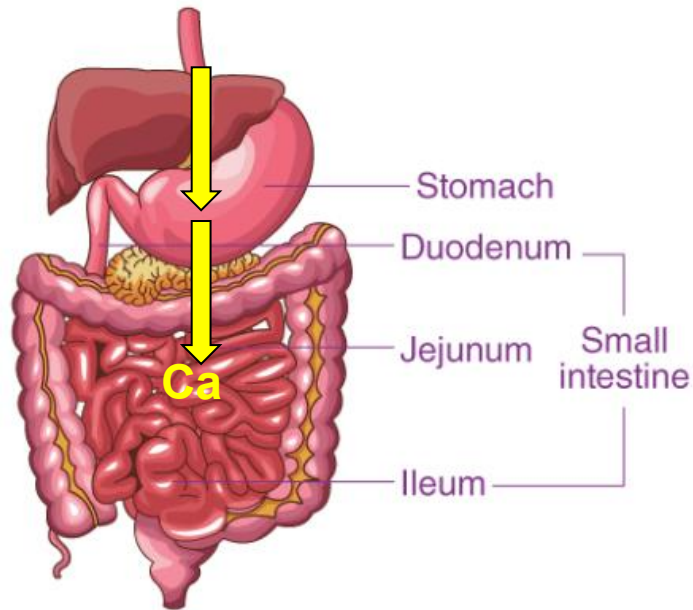


Bone mass changes with age

Weaver et al. (2016)



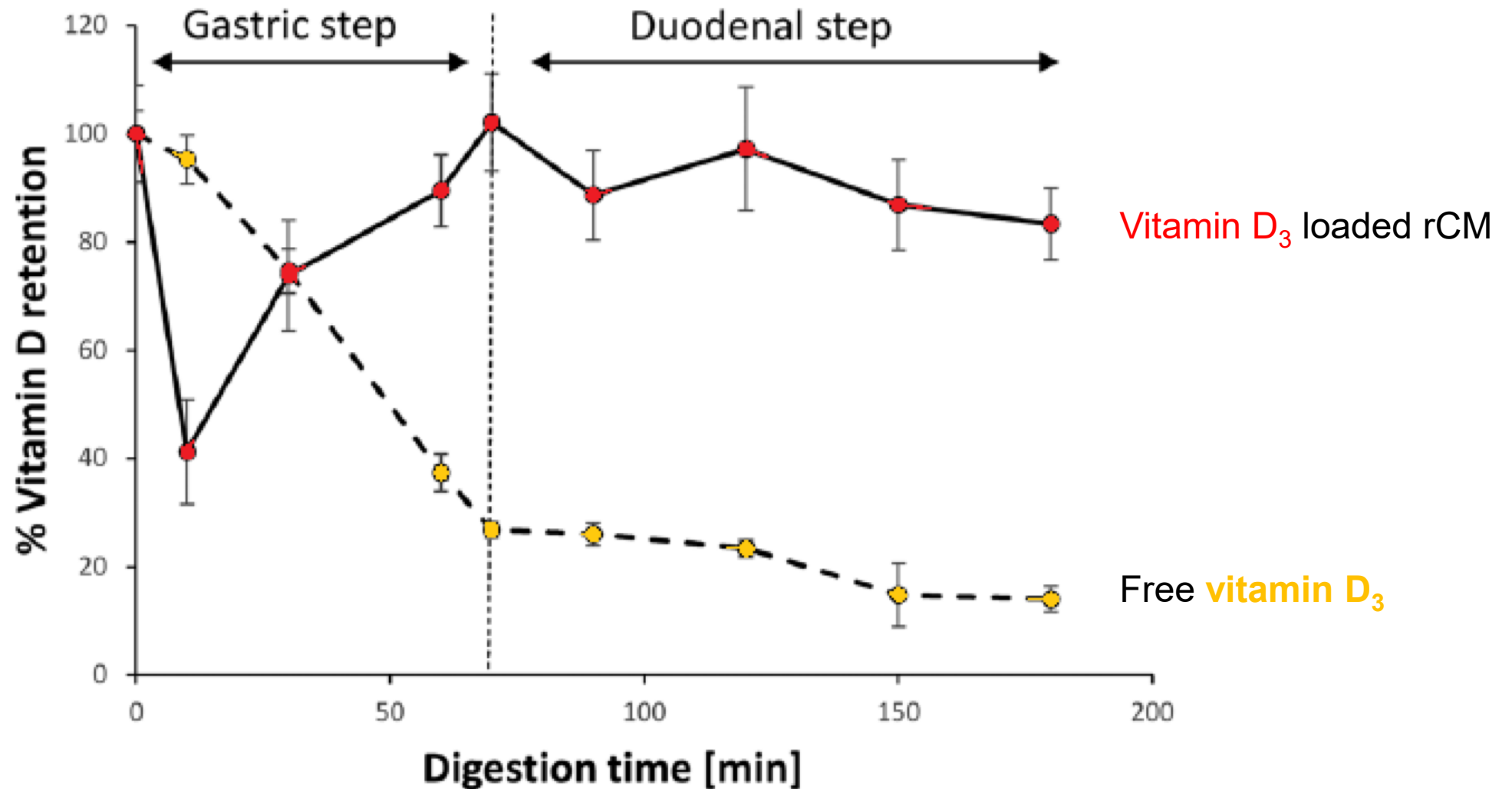
The casein micelle: a Ca and P carrier function: a matrix within a matrix



Casein micelle
 Ca phosphate supersaturated
 i.e. greatly > solubility

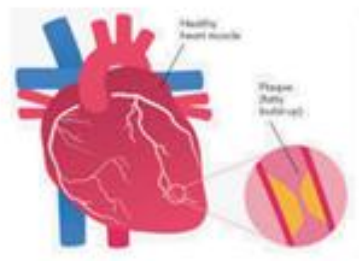
Re-assembled casein micelles (rCM) improve in vitro bioavailability of vitamin D in a Caco-2 cell model

Cohen et al., 2016





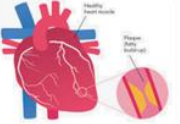


Middle Age:
That time when
you finally get your
head together-
then your
**BODY STARTS
FALLING APART!**

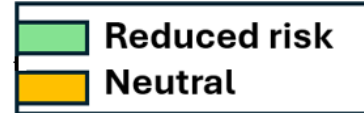


Association between dairy intake and cardiometabolic diseases

Givens (2023) Proc. Nutr. Soc. 82: 320-345

A selection of dose-response meta-analyses of PCSs

Disease outcome/dairy foods	RR* (95 % confidence interval)	
CVD		
 Milk (per 244 g/d)	1.01 (0.93, 1.10)	Neutral
Cheese (per 10 g/d)	0.98 (0.95, 1.00)	Neutral
Butter (per 14 g/d)	1.00 (0.98, 1.02)	Neutral
Yoghurt (per 50 g/d)	1.03 (0.97, 1.09)	Neutral
Total dairy (>2 servings/d v. none)	0.78 (0.67, 0.90)	Reduced risk
Stroke		
 Milk (per 200 g/d)	0.93 (0.88, 0.98)	Reduced risk
Milk (per 200 g/d)	0.92 (0.88, 0.97)	Reduced risk
Cheese (per 40 g/d)	0.97 (0.94, 1.01)	Neutral
Butter (per 14 g/d)	1.01 (0.93, 0.99)	Reduced risk
Total dairy (>2 servings/d v. none)	0.66 (0.53, 0.82)	Reduced risk
Type 2 Diabetes		
 Butter (per 14 g/d)	0.96 (0.93, 0.99)	Reduced risk
Yoghurt (per 80 g/d)	0.86 (0.83, 0.90)	Reduced risk
Yoghurt (per 100 g/d)	0.94 (0.91, 0.97)	Reduced risk
Yoghurt (>0.5 servings/d)	0.89 (0.82, 0.96)	Reduced risk
Yoghurt (standardised)	0.73 (0.70, 0.76)	Reduced risk

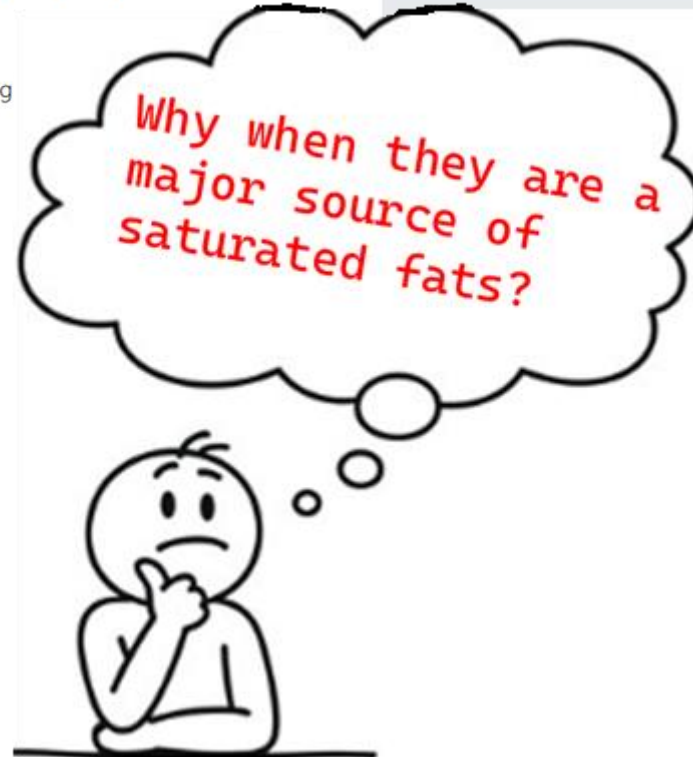


RESEARCH
Open Access

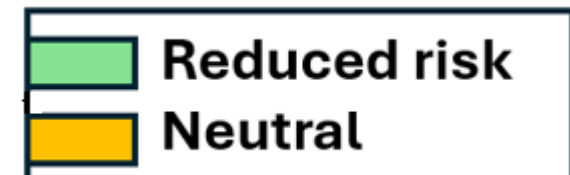

Association of milk consumption with all-cause mortality and cardiovascular outcomes: a UK Biobank based large population cohort study

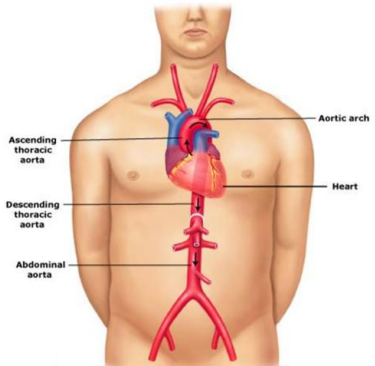
 Jian Zhou¹, Ziyi Wu¹, Zhengjun Lin¹, Wanchun Wang¹, Rongjun Wan^{2,3*} and Tang

450,507 participants



Dairy consumption vs:	HR	95% CI	Value
CVD events			
Milk full cream	0.97	0.88-1.07	Neutral
Semi-skimmed	0.89	0.81-0.97	Neutral
Skimmed	0.87	0.79-0.96	Reduced risk
Milk full cream	1.01	0.85-1.19	Neutral
Semi-skimmed	1.07	0.93-1.24	Neutral
Skimmed	1.08	0.93-1.26	Neutral
Milk full cream	0.91	0.78-1.06	Neutral
Semi-skimmed	0.82	0.72-0.93	Reduced risk
Skimmed	0.80	0.70-0.92	Reduced risk



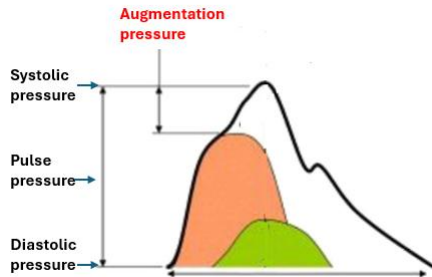


Does Dairy Stiffness Evidence

Katherine M. Livingstone

Hypertension • Volume

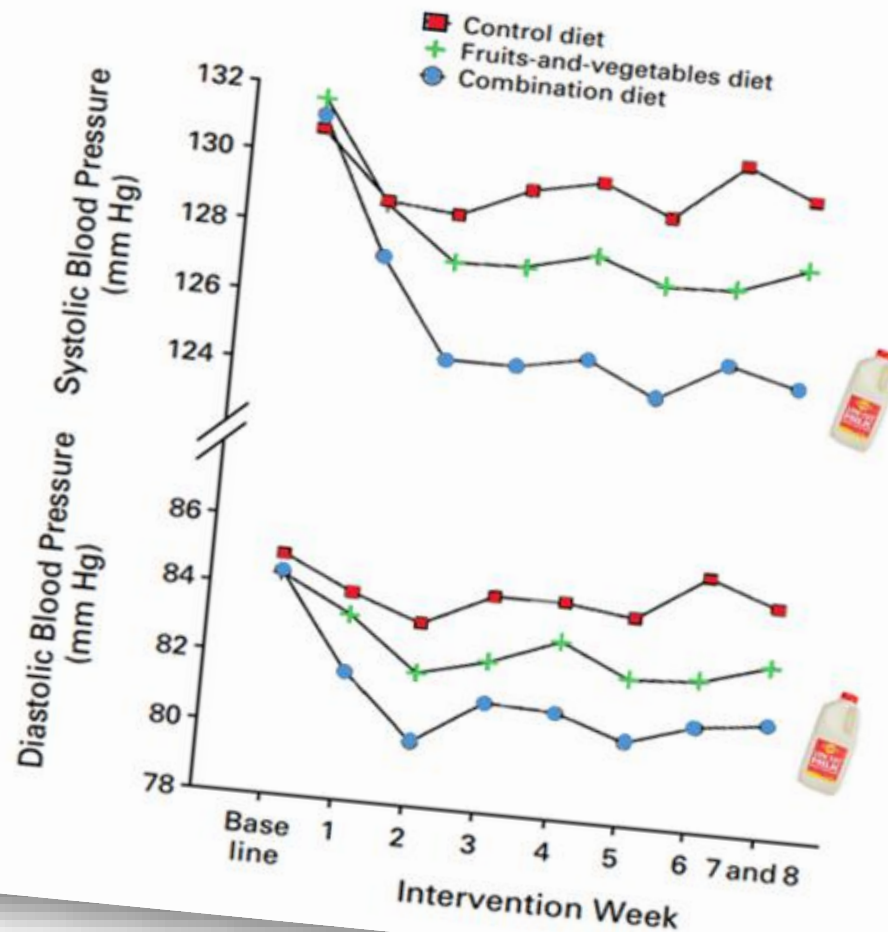
$$AI = AP/PP * 100$$



- 787
- Aug proc
- Hig 10.
- Re blc bu m



Appel et al. 1997
NEJM 336: 1117-24

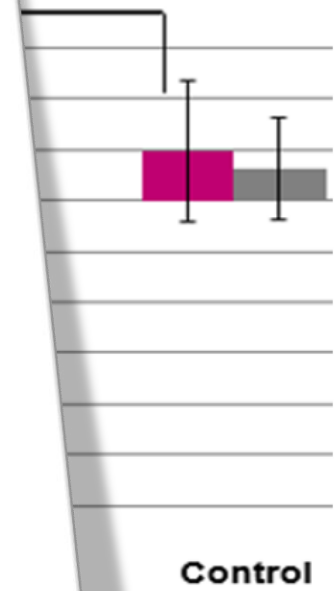
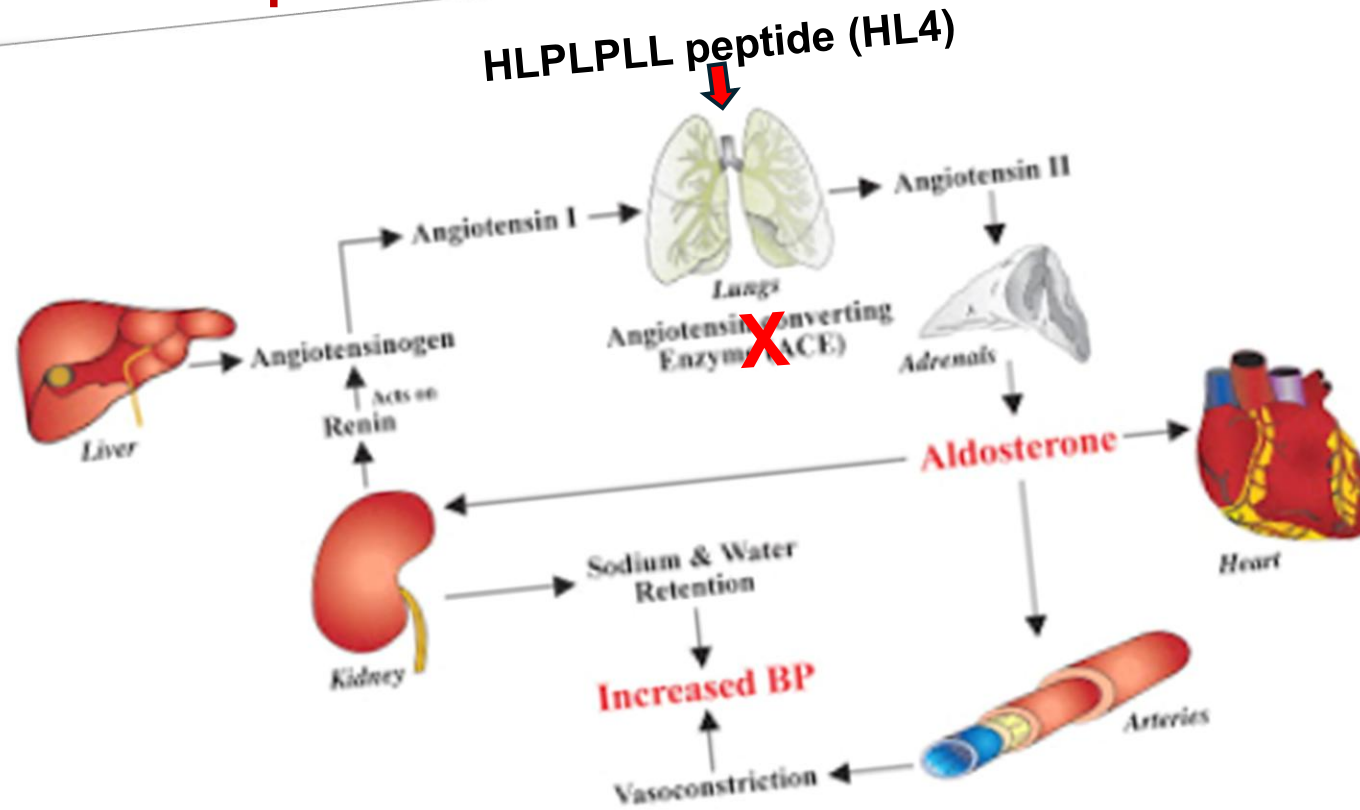


quintiles of dairy
(p=0.021)
blood pressure was
lower in consumers
of dairy in a prospective
study, excluding
metabolic

Hypotensive peptides released from milk proteins during digestion

Fekete et al., 2016

DBP



Control

Renin-angiotensin-aldosterone system

$p=0.007$,

treatment effect for DP $p=0.095$,

Overall treatment effect for Mean P $p=0.009$

Fitzgerald

Potent casokinins

Protein

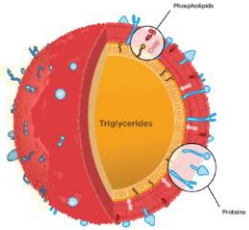
Casokinins

α _{s1} -casein	f(25)
α _{s2} -casein	f(17)
β -casein	f(74)
κ -casein	f(18)
Lactokinins	
α -lactalbumin	f(104)
β -lactoglobulin	f(142)
BSA ⁴	f(208)

- 1 One letter amino acid
- 2 Angiotensin-I-converting enzyme
- 3 Concentration of peptide
- 4 Bovine serum albumin

Effect of 40 g fat/day for 8 weeks from whipping cream and butter oil: effect of MFGM on plasma lipids

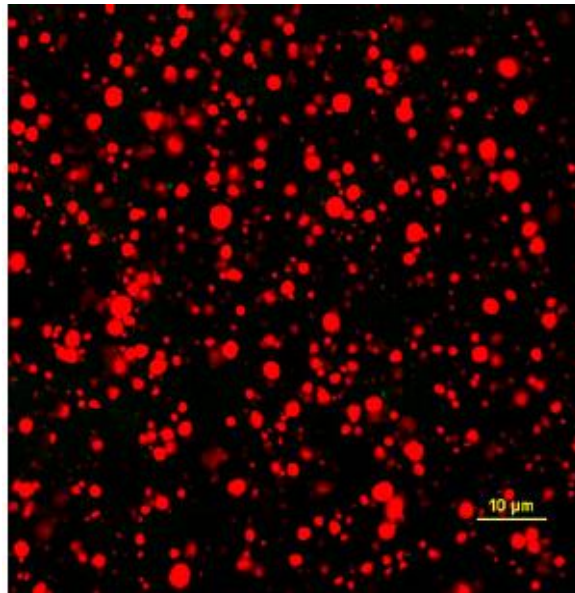
Rosqvist et al., 2015



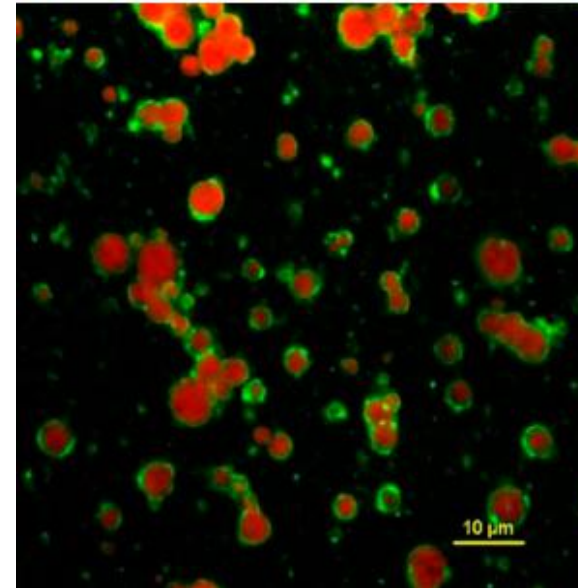
Confocal laser scanning micrographs



milknutritiousbynature.eu



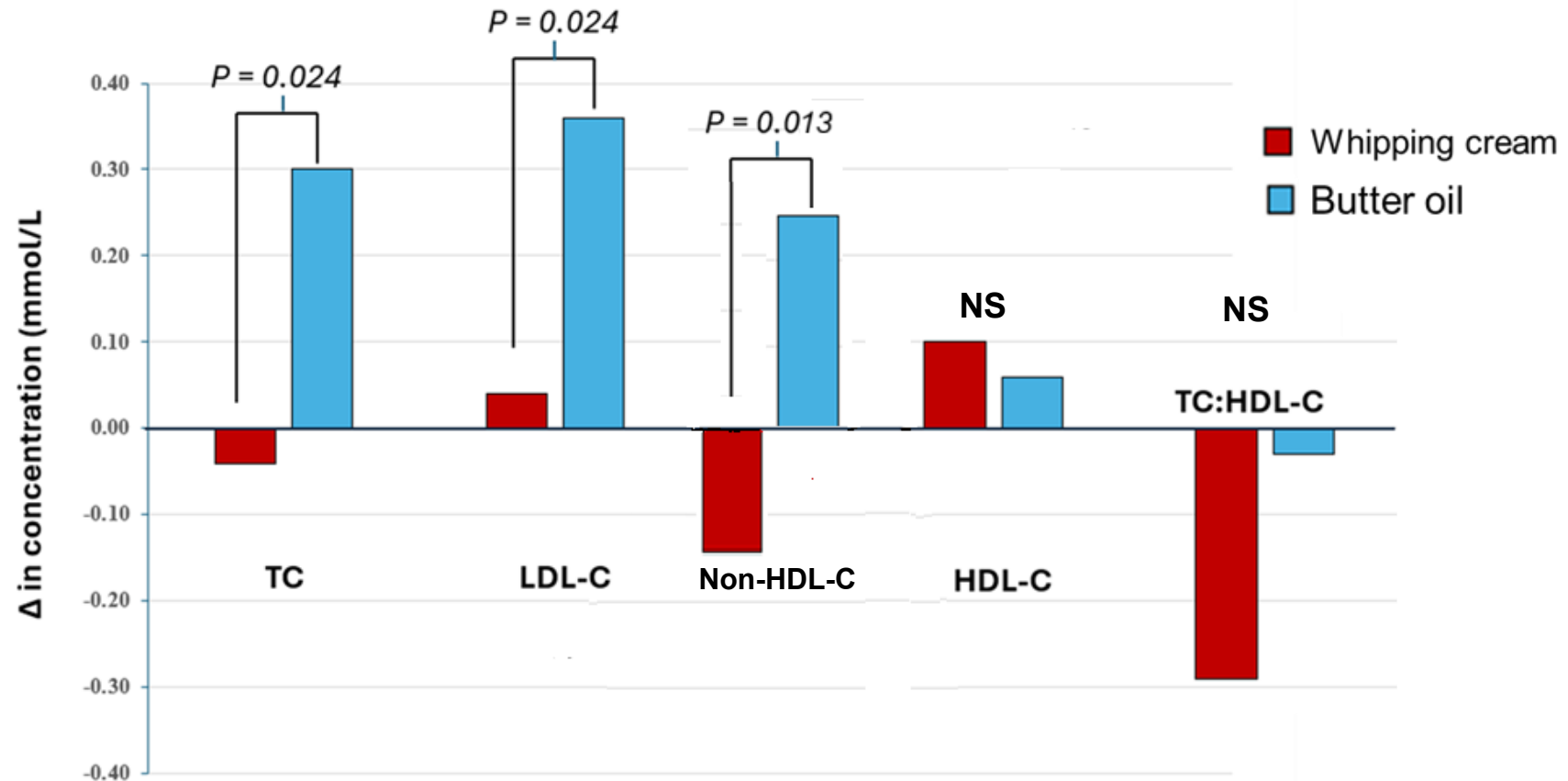
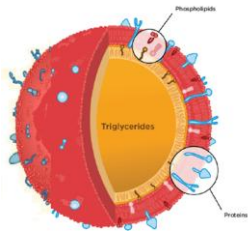
Milk fat globules in emulsion
from butter oil
Fat=red; MFGM=green



Milk fat globules from
whipping cream
Fat=red; MFGM=green

Effect of 40 g fat/day for 8 weeks from whipping cream and butter oil: effect of MFGM on plasma lipids

Rosqvist et al., 2015



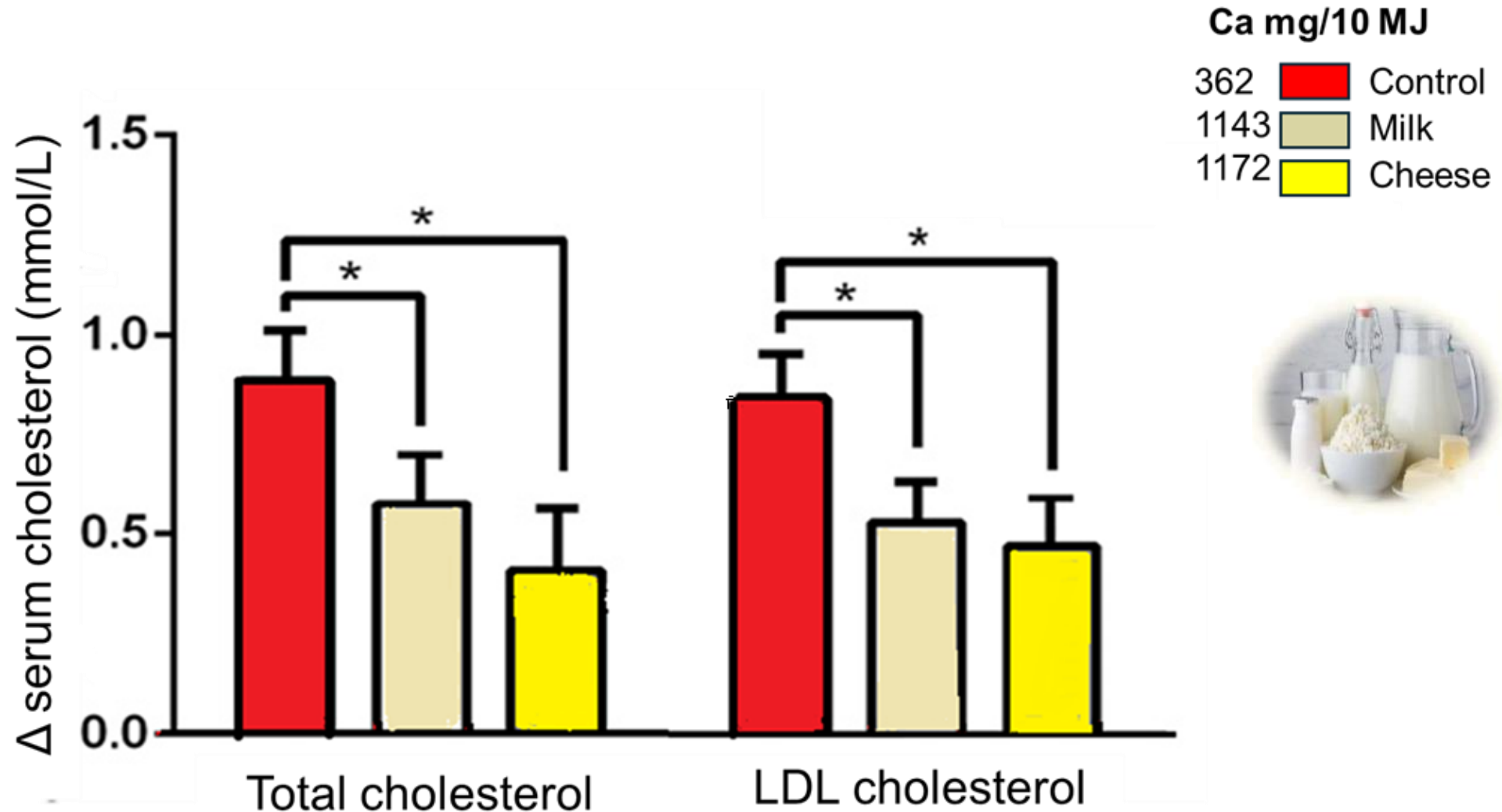
Health effects of a dairy food cannot be determined simply on its fat content

Effect dairy Ca from cheese and milk on blood lipids in young men (~46g SFA/d)

Soerensen et al., 2014

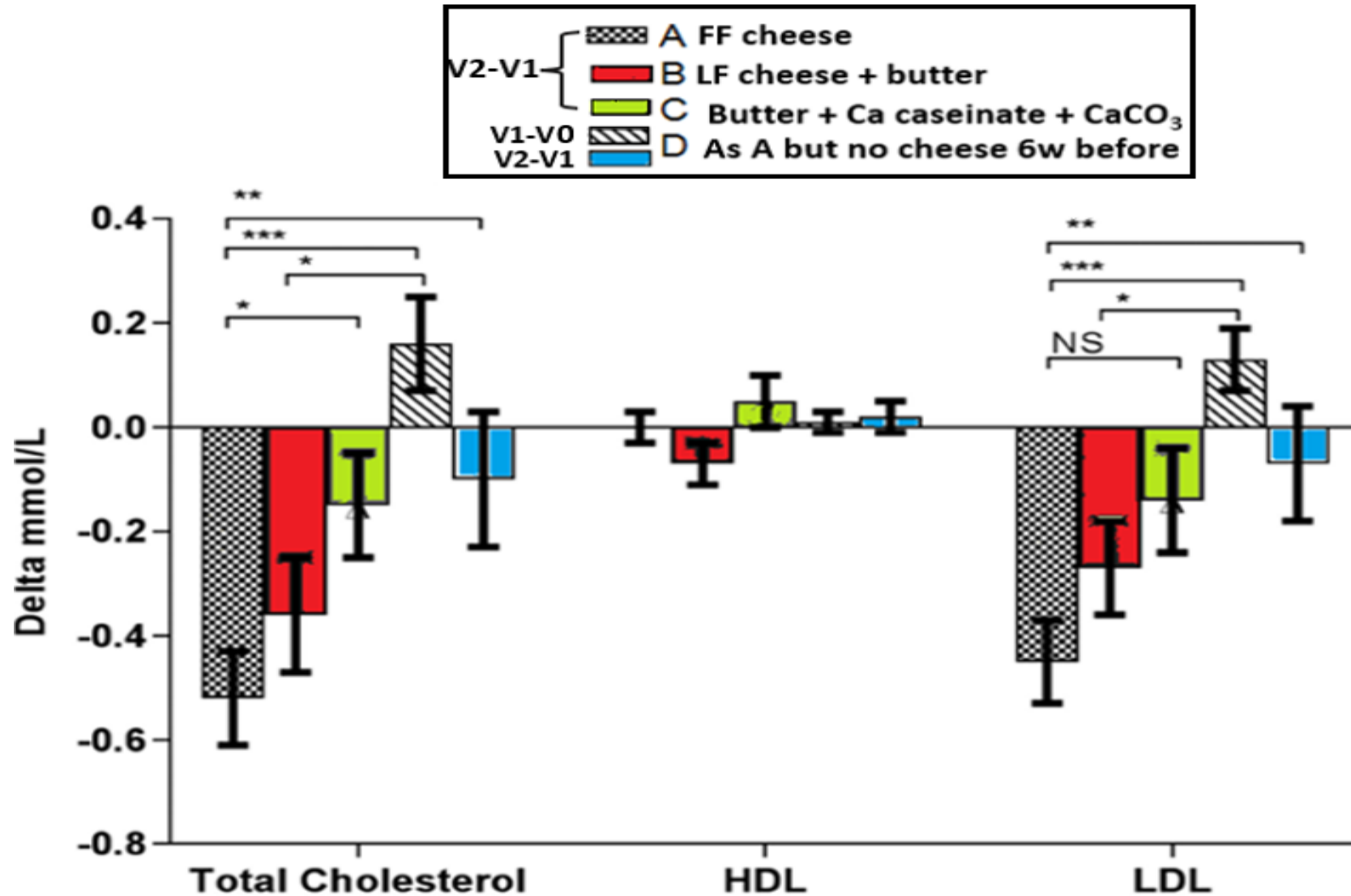


milknutritiousbynature.eu



Response to dairy fat differs when in cheese matrix (~40g fat/d; 6w parallel)

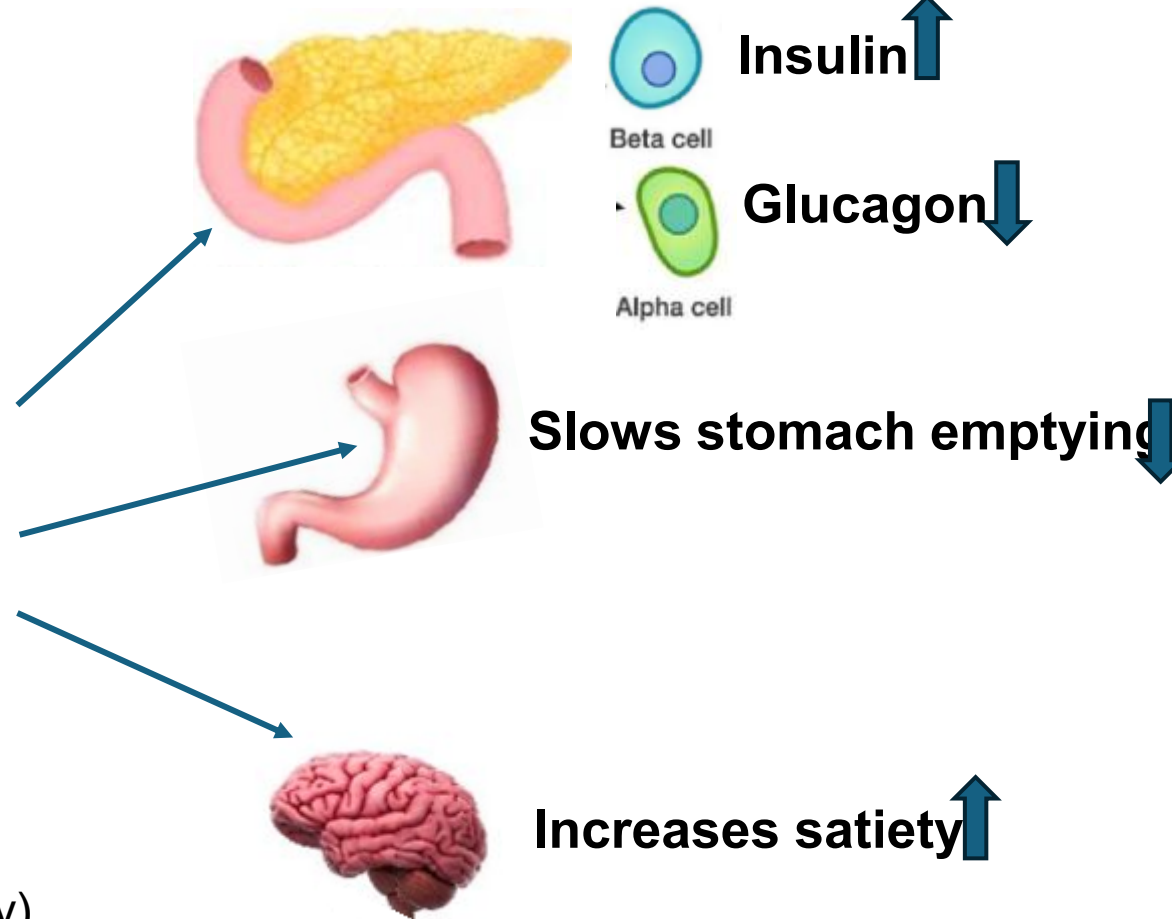
Feeney et al., 2018



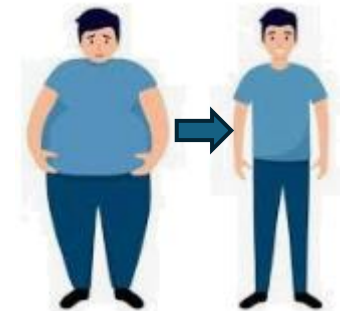


GLP-1 Receptor agonists

[mimic the action of natural GLP-1]



Outcomes

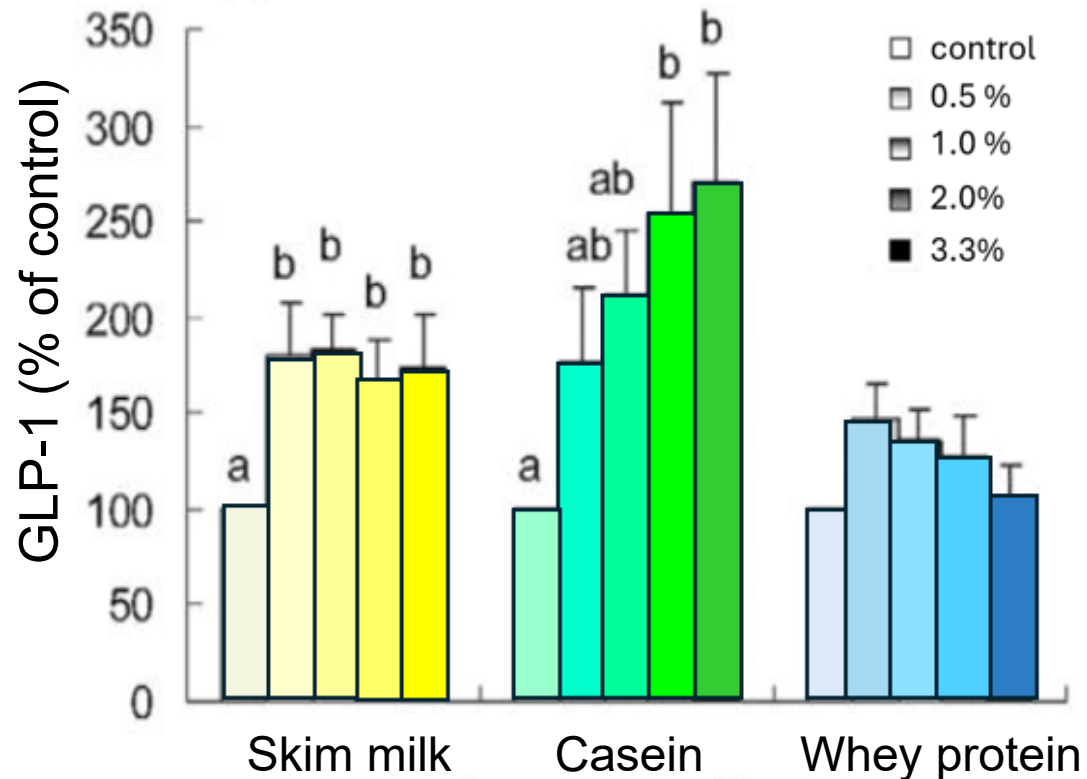


- Dulaglutide (Trulicity)
- Exenatide (Bydureon)
- Liraglutide (Saxenda*, Victoza)
- Lixisenatide (Suliqua)
- Semaglutide (Wegovy*, Ozempic, Rybelsus)

*authorised for weight management

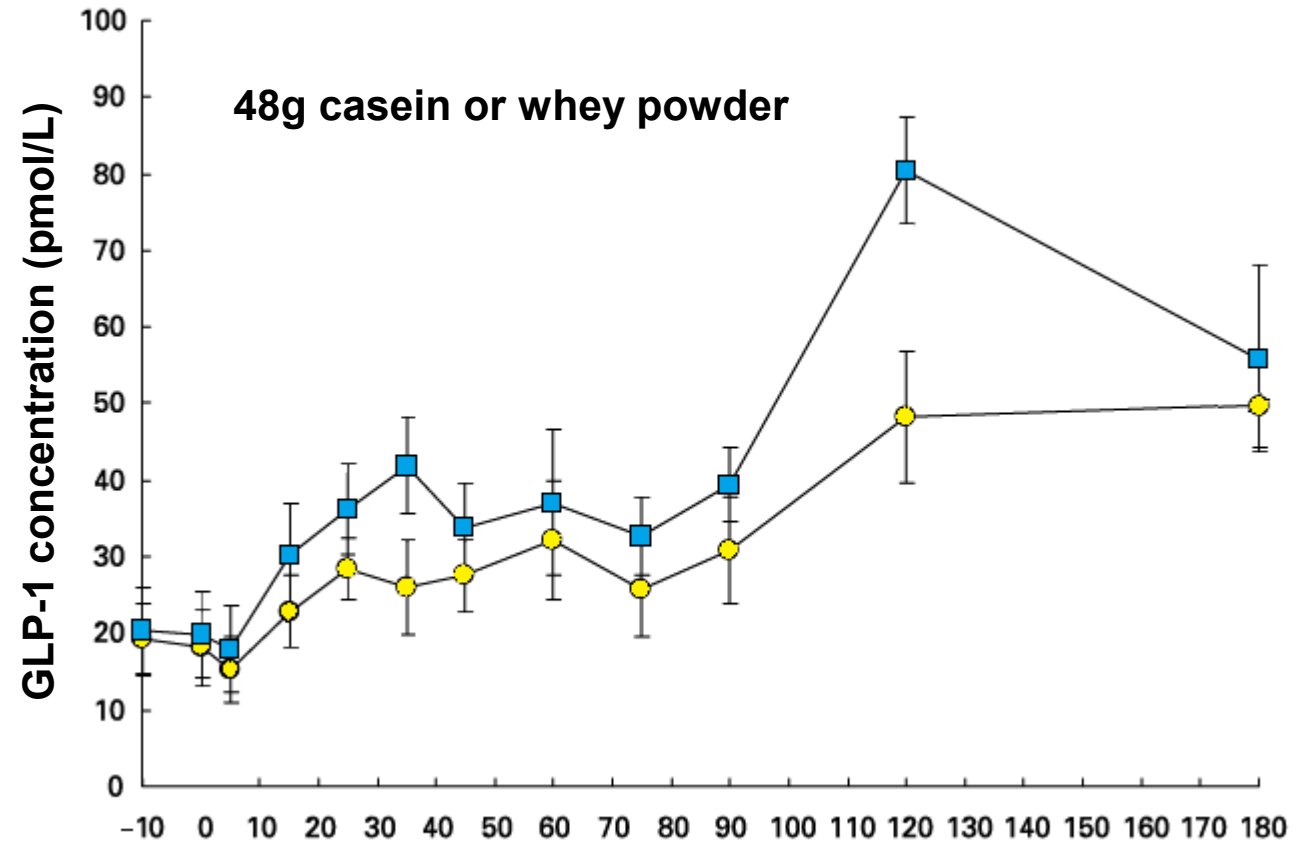
Dose-response human cell study

Chen & Reimer 2008



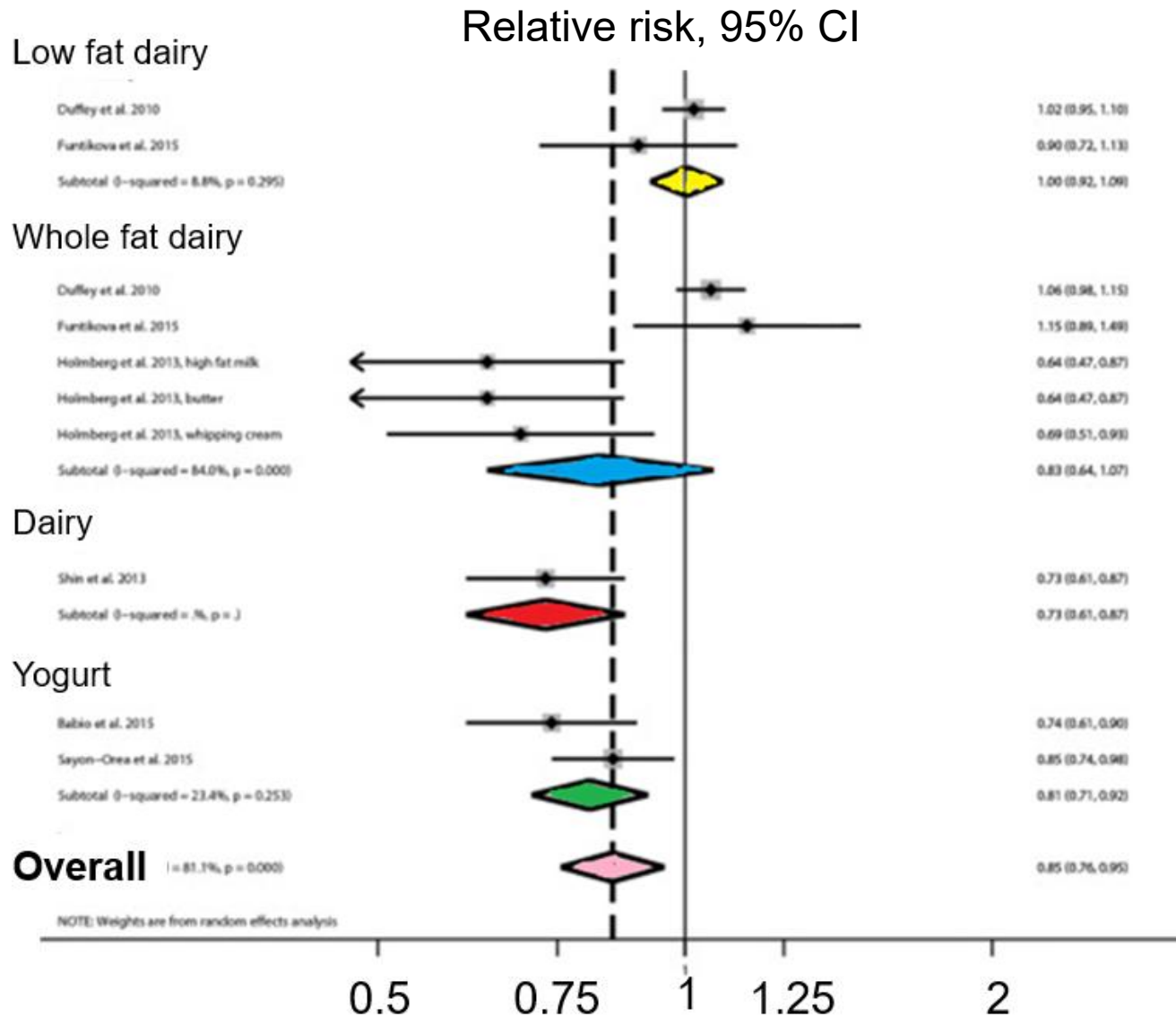
Human time course study

Hall et al., 2003



Association of dairy products and abdominal adiposity

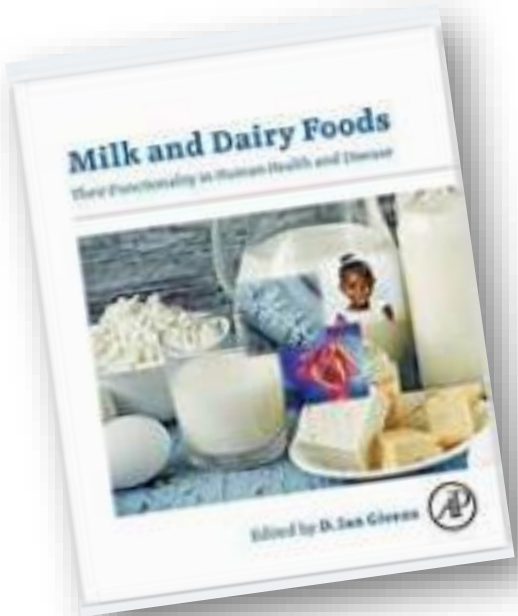
Schwingshackl et al. 2016
PloS One 11: e0157461



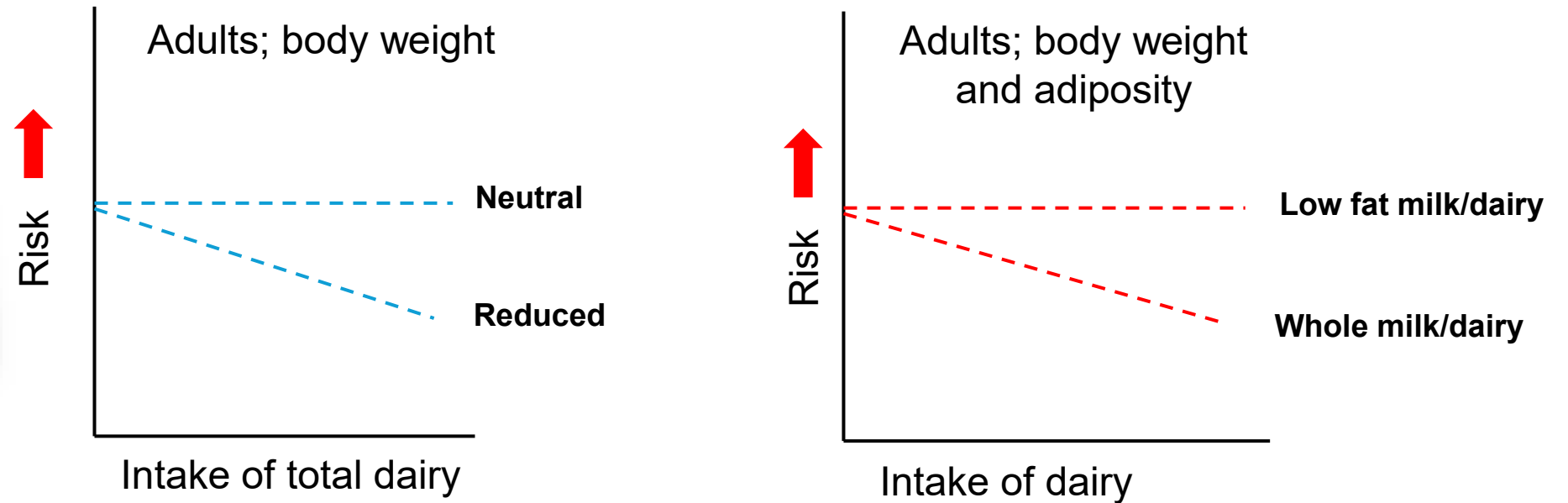
Negative association
with waist circumference

Association of dairy products and body weight and adiposity

Dougkas et al. 2020



77 longitudinal studies



High heterogeneity

The Milky Way Study



Nicholl et al. 2021



The effects of **whole-fat** compared with **reduced-fat dairy** intake over **3 months** on measures of adiposity and biomarkers of cardiometabolic risk in healthy 4 to 6-y-old children.

- Dairy fat intake 12.9 ± 4.1 g/day higher in whole-fat group
- Daily energy intakes not significantly different
- No significant effects on:
 - Any measure of adiposity
 - Body composition
 - Blood pressure
 - Serum lipids, glucose, HbA1c, CRP



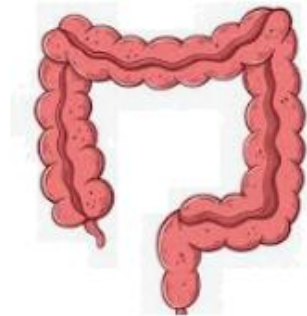
LATER LIFE



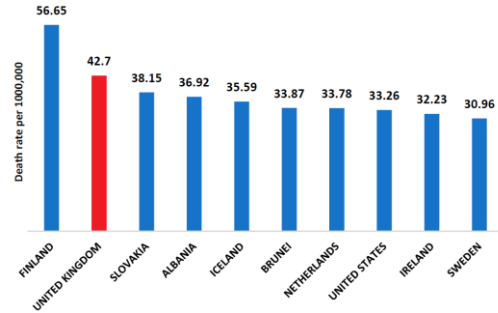
The brain



Skeletal
muscle

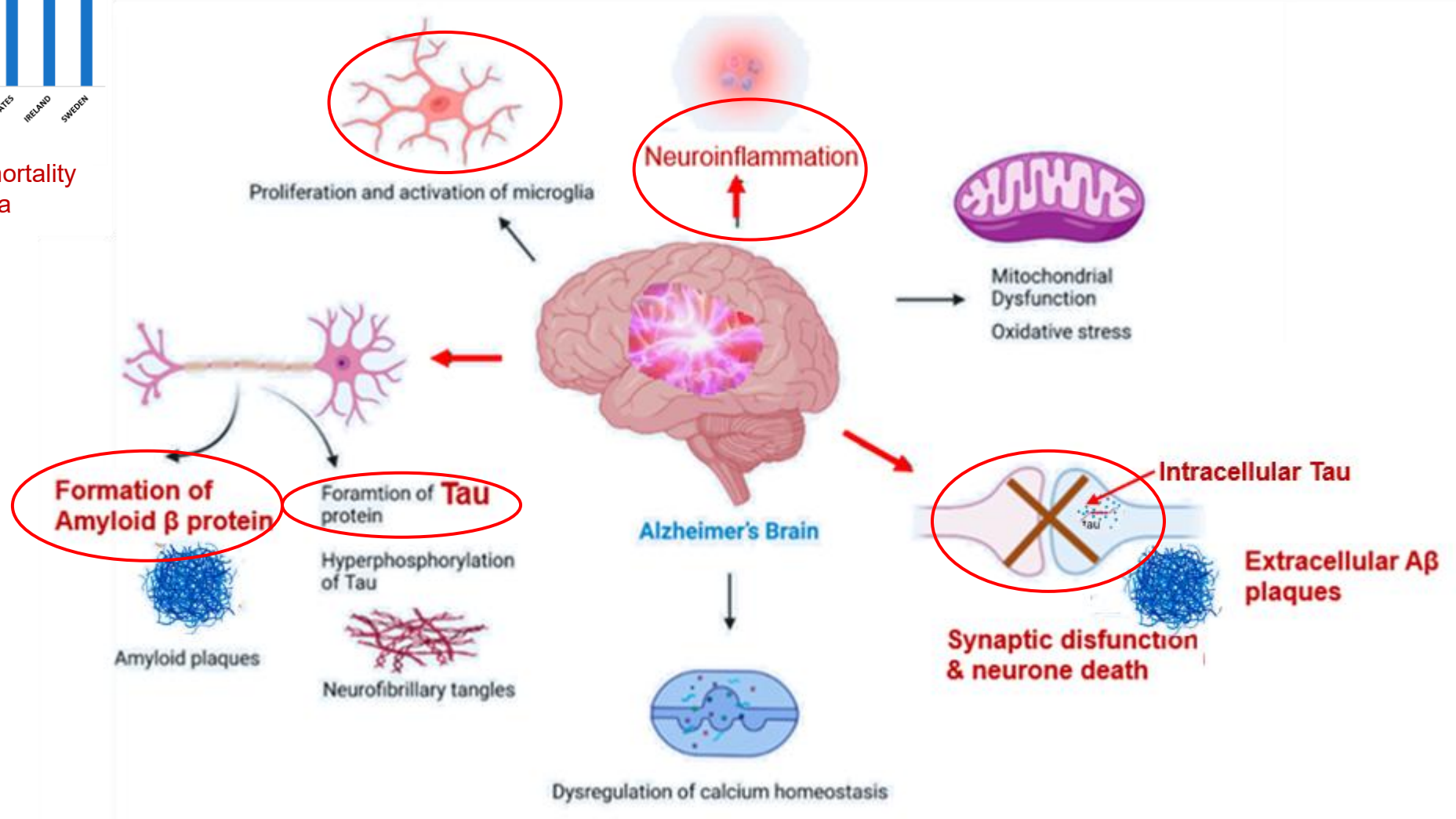


Colorectum

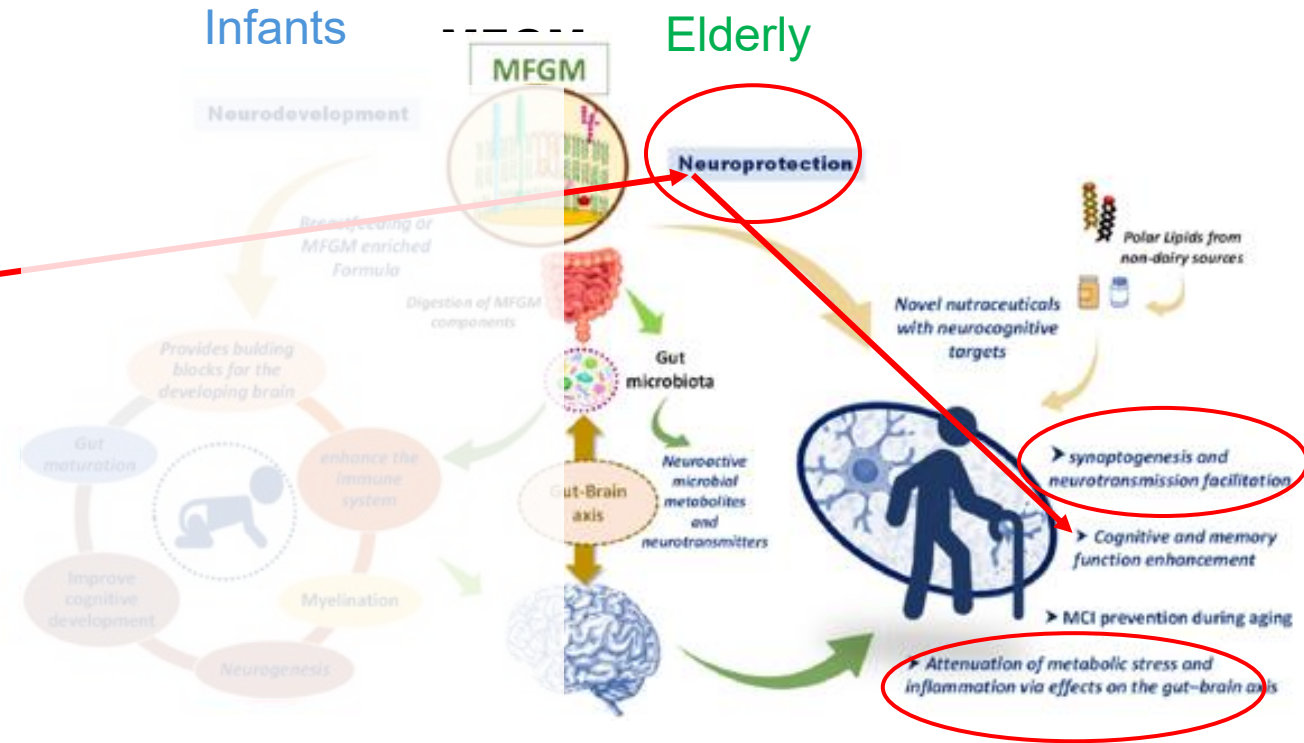
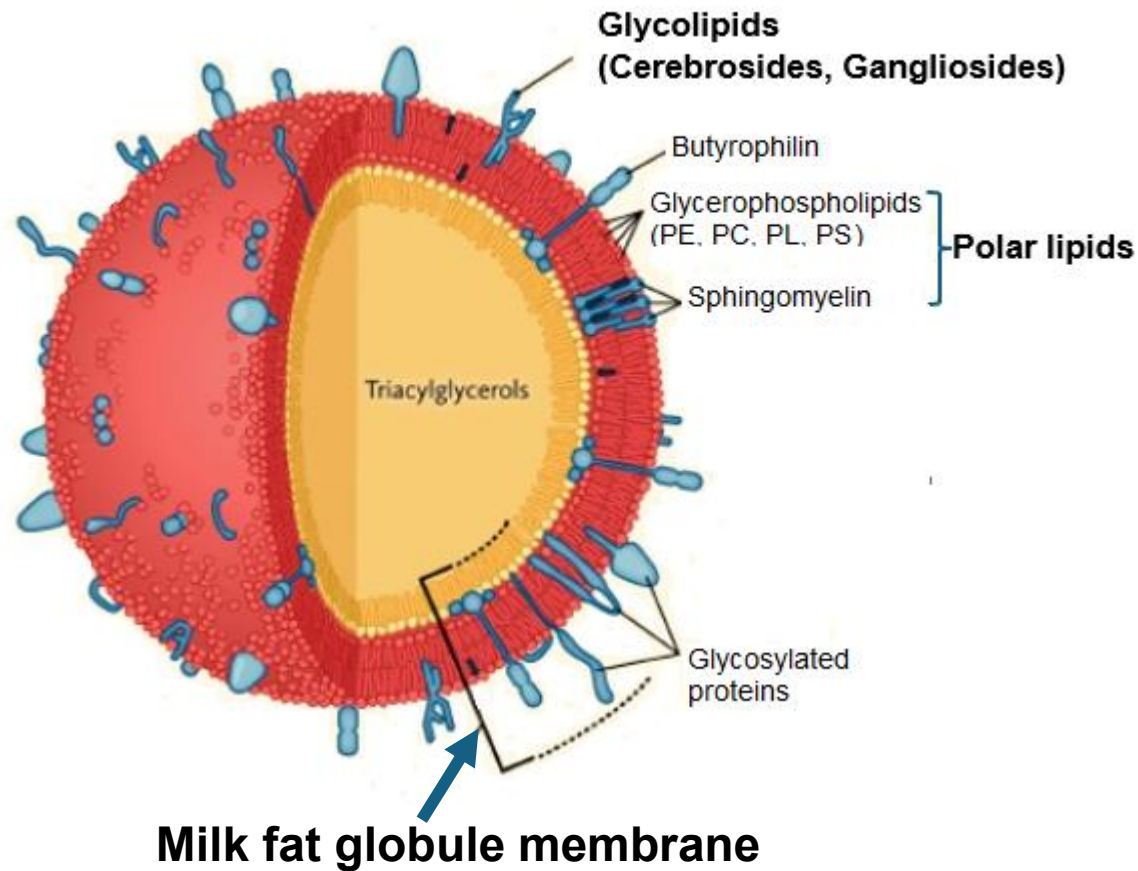


Countries with highest mortality rate from dementia

Sehar et al. 2022



Benefits of the milk fat globule membrane for neuroprotection in the elderly



Potential health roles of MFGM components

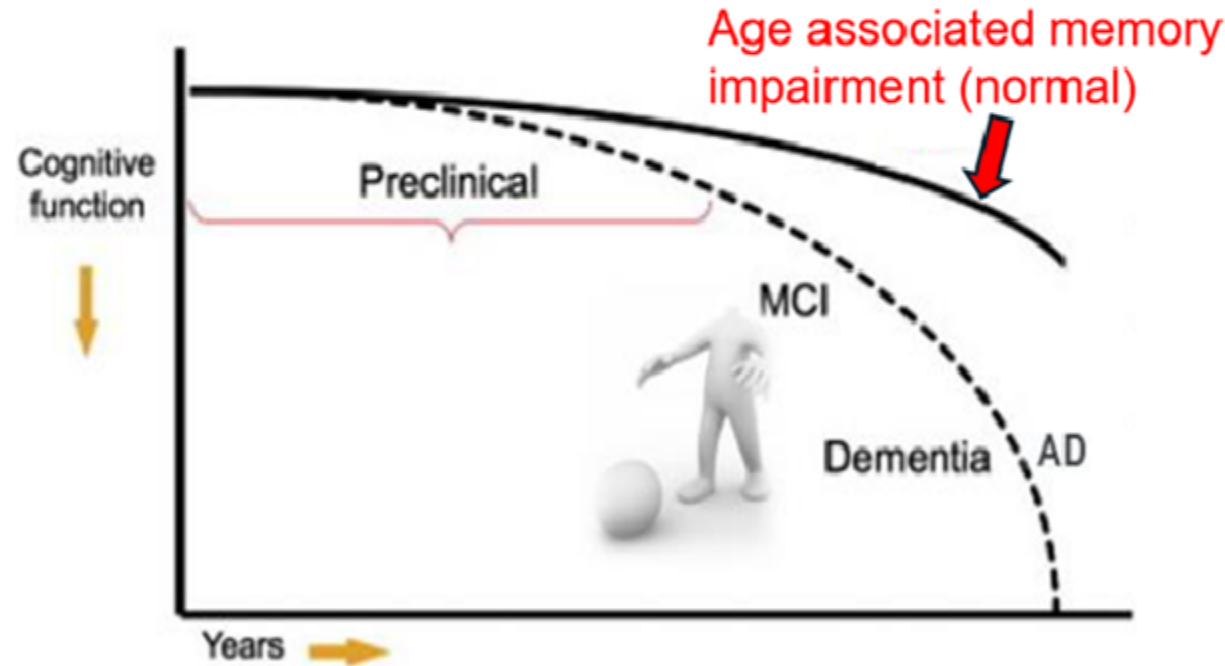
Milk fat globule membrane and its polar lipids: reviewing preclinical and clinical trials on cognition

Cite this: *Food Funct.*, 2024, 15, 6783

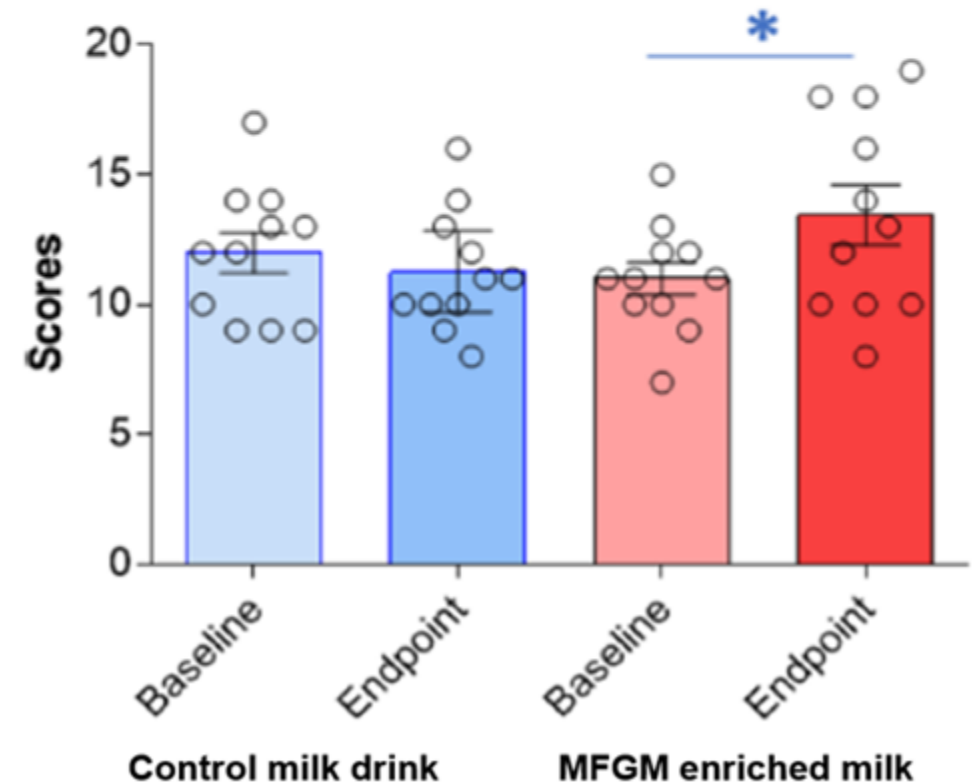
Álvaro Luque-Uría, ^a María V. Calvo, ^a Francesco Visioli ^{b,c} and Javier Fontecha ^{a*}



Calvo et al., 2023

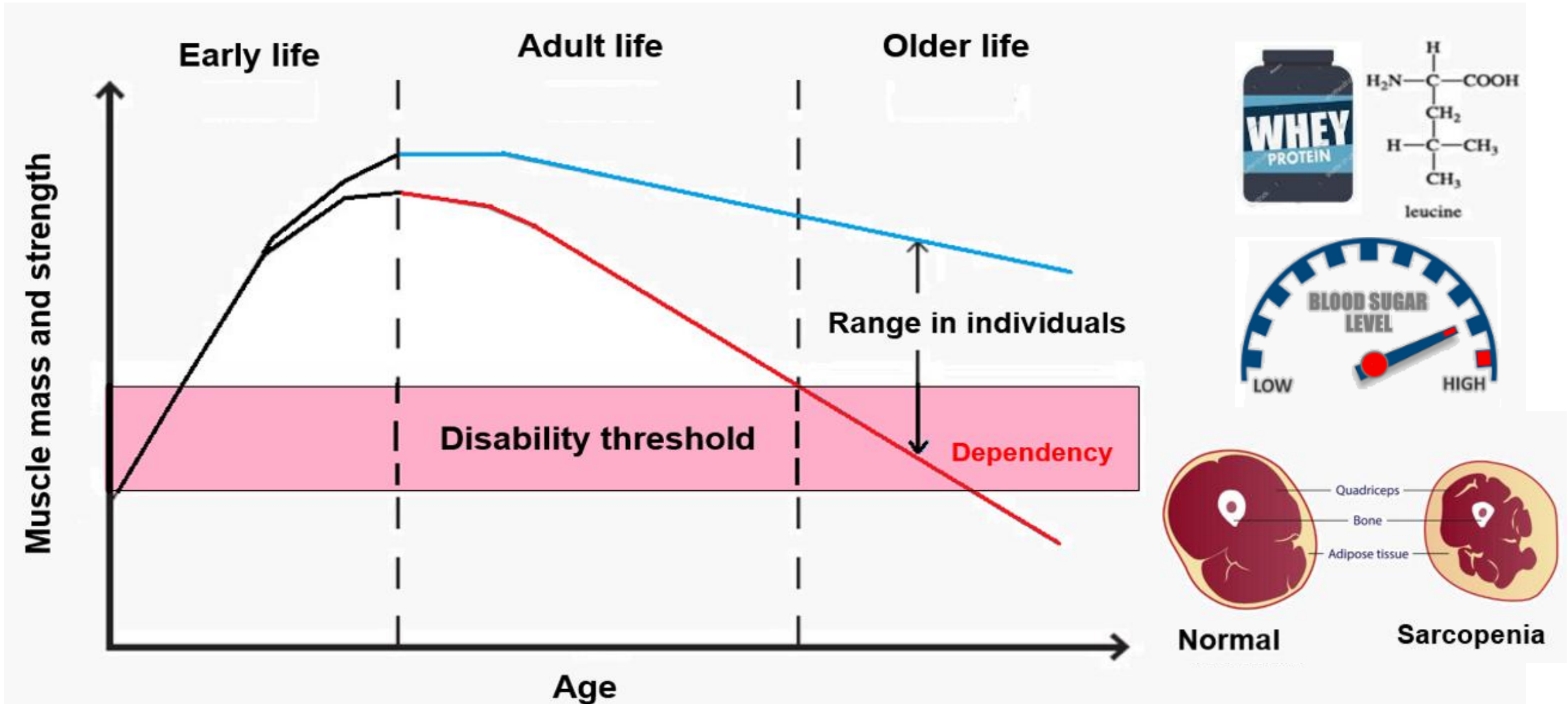


Short-delay cued recall in women after 14 weeks



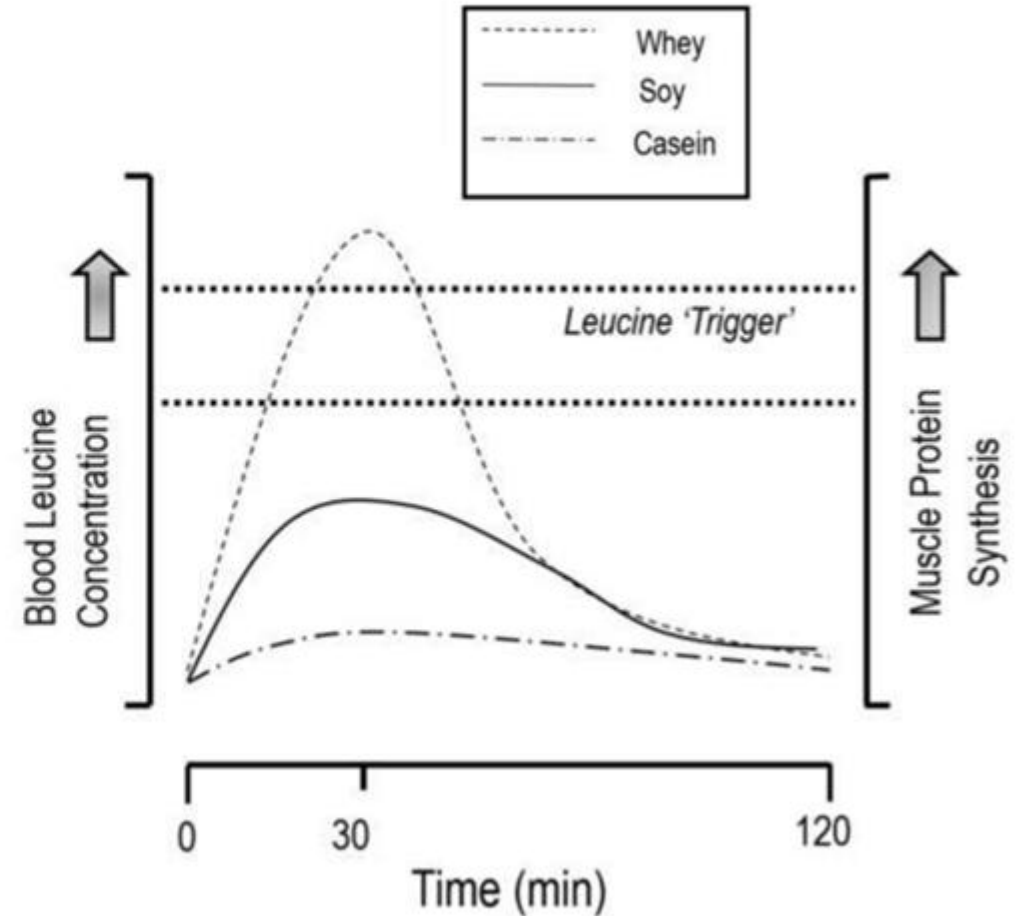
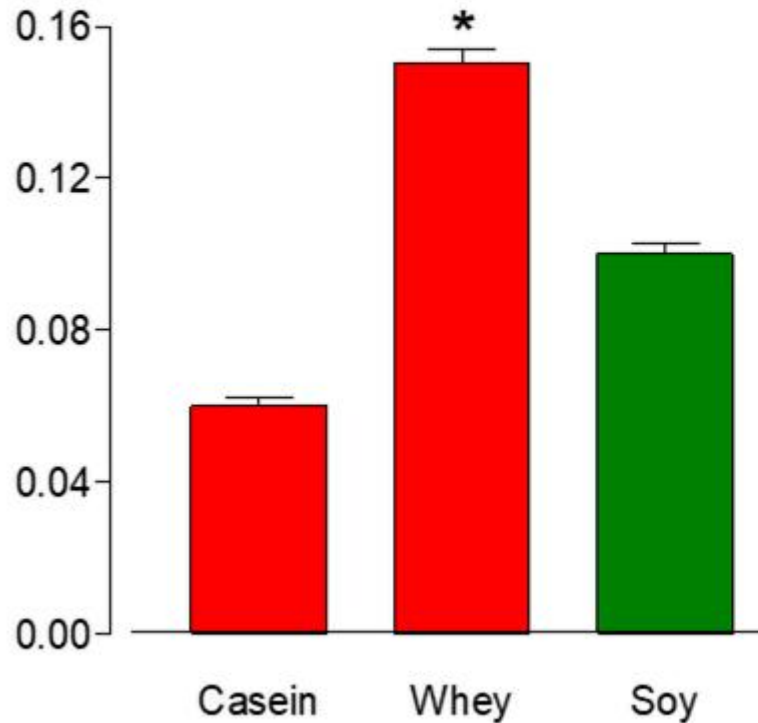
Ageing is associated with a gradual loss of skeletal muscle mass and strength

Sayer et al. 2013, Age and Ageing 42: 145-150



The functionality of milk proteins for stimulation of muscle protein synthesis

Mixed-MPS (%/h)





Dairy and colorectal cancer

WCRF/AICR, 2018

World Cancer Research Fund | American Institute for Cancer Research | CUP Continuous Update Project

Analysing research on cancer prevention and survival

2017	DIET, NUTRITION, PHYSICAL ACTIVITY AND COLORECTAL CANCER		
		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 Foods containing dietary fibre ⁷ Dairy products ⁸ Calcium supplements ⁹	Red meat ¹⁰
LIMITED EVIDENCE	Limited – suggestive	Foods containing vitamin C ¹¹ Fish Vitamin D ¹² Multivitamin supplements ¹³	Low intakes of non-starchy vegetables ¹⁴ Low intakes of fruits ¹⁴ Foods containing haem iron ¹⁵
	Limited – no conclusion	Cereals (grains) and their products; potatoes; animal fat; poultry; shellfish and other seafood; fatty acid composition; cholesterol; dietary n-3 fatty acid from fish; legumes; garlic; non-dairy sources of calcium; foods containing added sugars; sugar (sucrose); coffee; tea; caffeine; carbohydrate; total fat; starch; glycaemic load; glycaemic index; folate; vitamin A; vitamin B6; vitamin E; selenium; low fat; methionine; beta-carotene; alpha-carotene; lycopene; retinol; energy intake; meal frequency; dietary pattern	
STRONG EVIDENCE	Substantial effect on risk unlikely		

nature communications

Papier et al., 2025



Article

<https://doi.org/10.1038/s41467-024-55219-5>

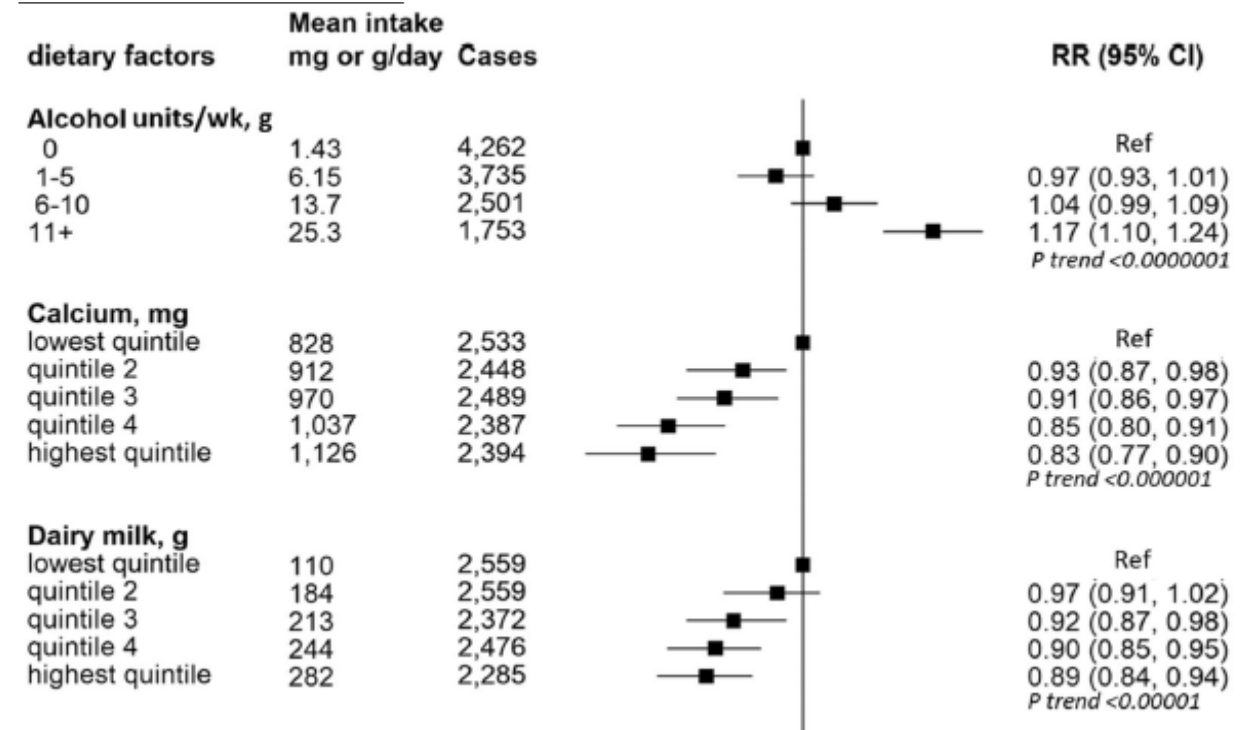
Diet-wide analyses for risk of colorectal cancer: prospective study of 12,251 incident cases among 542,778 women in the UK

Received: 3 July 2024

Accepted: 3 December 2024

Published online: 08 January 2025

Keren Papier¹✉, Kathryn E. Bradbury^{2,10}, Angela Balkwill¹, Isobel Barnes¹, Karl Smith-Byrne¹, Marc J. Gunter^{3,4}, Sonja I. Berndt⁵, Loic Le Marchand⁶, Anna H. Wu⁷, Ulrike Peters⁸, Valerie Beral^{1,9}, Timothy J. Key¹ & Gillian K. Reeves¹



Dairy, calcium and colorectal cancer: further exploration

Papier et al., 2025

MCM6 gene

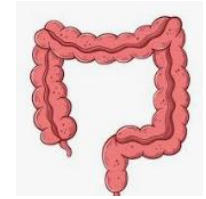


Table 4 | Associations of sources of dietary calcium with colorectal cancer risk

Calcium source	Cases	RR (95% CI) ¹
Dairy sources, by quintiles of intake²		
1	2577	1
2	2465	0.93 (0.88,0.99)
3	2425	0.90 (0.85,0.96)
4	2432	0.90 (0.85,0.95)
5	2352	0.86 (0.81,0.92)
Non-dairy sources, by quintiles of intake³		
1	2403	1
2	2482	1.00 (0.94, 1.06)
3	2467	0.97 (0.91, 1.04)
4	2457	0.95 (0.89, 1.02)
5	2442	0.94 (0.86, 1.01)
<i>P for heterogeneity</i>		0.21

MR Study using lactase polymorphism SNP

Inverse association of MR predicted milk intake with CRC risk was larger than from reported milk intake:

RR (MR) per 200g/d=0.60 (95%CI 0.46-0.75)

vs:

RR (Rep) per 213g/d=0.92 (95%CI 0.87-0.98)

MR studies provide evidence of a causal association, and the SNP used relates to effect of lactose exposure throughout adult life



- Dairy foods can provide functionality that cannot be explained by nutrient intake although some nutrients (e.g. Ca) may be involved.
- Many things are at an early stage but have considerable promise.
- Impacts on dementia would have massive impact, but when to start?



Nutrillac[®] MFGM is an opportunity to tap into this trend

Derived from sweet whey, Nutrillac[®] MFGM is high in whey protein and healthy lipids, such as phospholipids, and is a source of omega-3 fats, vitamin B12 and choline. The sum of these components is the secret of its nutritional power – and its potential in new functional food products.

		Outcome	Infant	Child	Adult
Cognition		Improved cognitive outcomes	✓ ²⁻⁵		✓ ^{16,17}
		Improved behavioral outcomes		✓ ¹⁵	✓ ²²
Gut & immunity		Reduced infections	✓ ⁶		
		Fewer days of fever	✓ ⁶	✓ ⁴	
		Reduced prevalence or length of diarrhoea episodes (or bloody diarrhoea)	✓ ⁷⁻¹⁴	✓ ⁴	✓ ¹⁸
Physical function & performance		Improving physical performance and strength			✓ ^{19,20}
Cardiometabolic health		Decreased lipid cardiometabolic markers			✓ ²¹
		Improved cholesterol profile	✓ ⁷⁻¹⁴		

Table: Documented health effects of MFGM in the infant, child and adult segments. Data from infant clinical and preclinical trials can be found in references 2-14. Data from toddler studies can be found in references 4, 15. Data for adult studies can be found in references 16-22.