Whole food *versus* supplements

Professor Michelle McKinley, Centre for Public Health, School of Medicine, Dentistry & Biomedical Science, Queen's University Belfast

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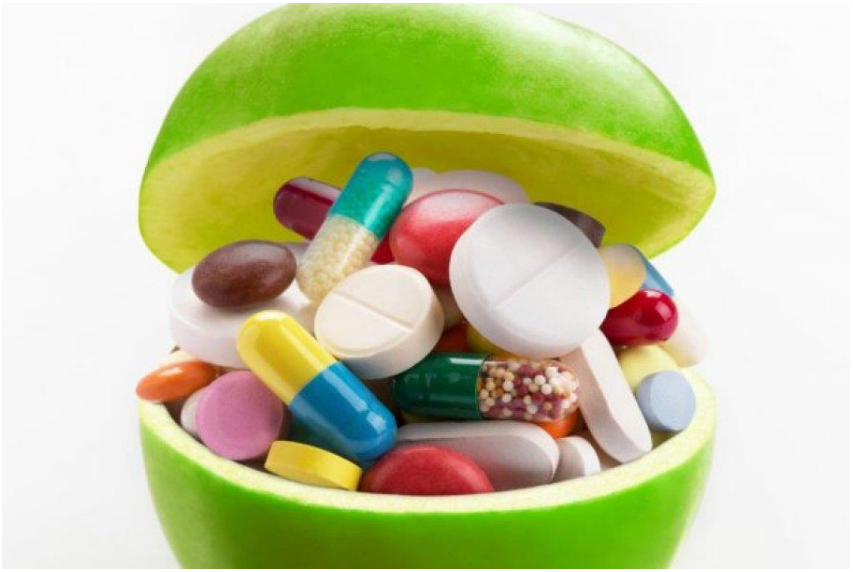
- Background
- Supplements versus whole diet and CVD
- Role of the food matrix in health
- Public health perspective on food *versus* supplements

Food supplement - definition



"Foodstuffs, the purpose of which is to supplement the normal diet and which are concentrate sources of nutrients or other substances with a nutritional or physiological effect, alone or in combination, marketed in dose form, namely forms such as capsules, pastilles, tablets, pills and other similar forms, sachets of powder, ampoules of liquids, drop dispensing bottles, and other similar forms of liquids and powders designed to be taken in measured small unit quantities"

EU Food Supplements Directive 2002/46/EC.

Supplement usage

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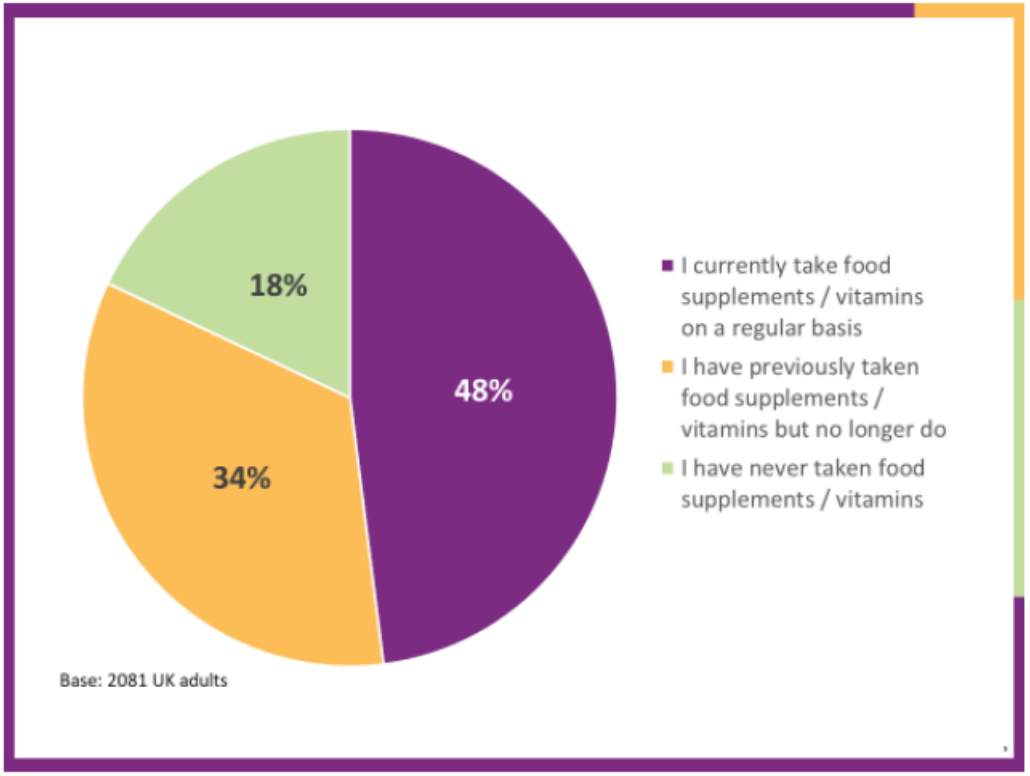
Food Supplements Consumer Research

Final Report for

Food Standards Agency
food.gov.uk

May 2018



Most commonly consumed

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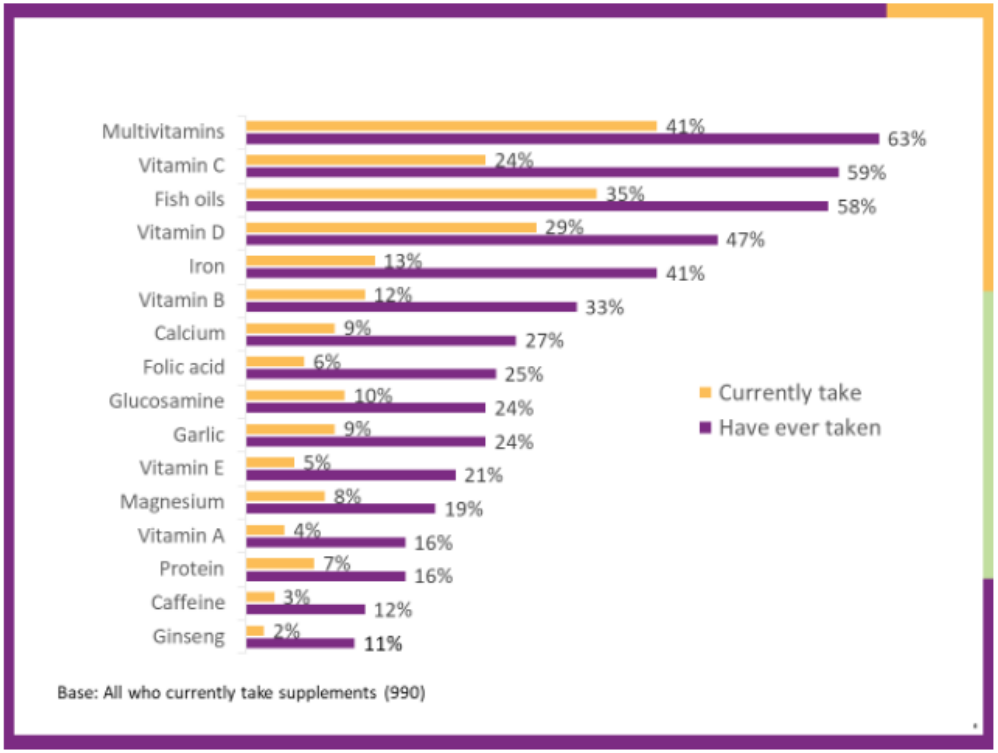
Figure 3: Which of the following supplements do you currently / have you ever taken?



Who is most likely to take supplements?

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- Older age groups
- Females
- Higher socioeconomic status

What do you take supplements for?

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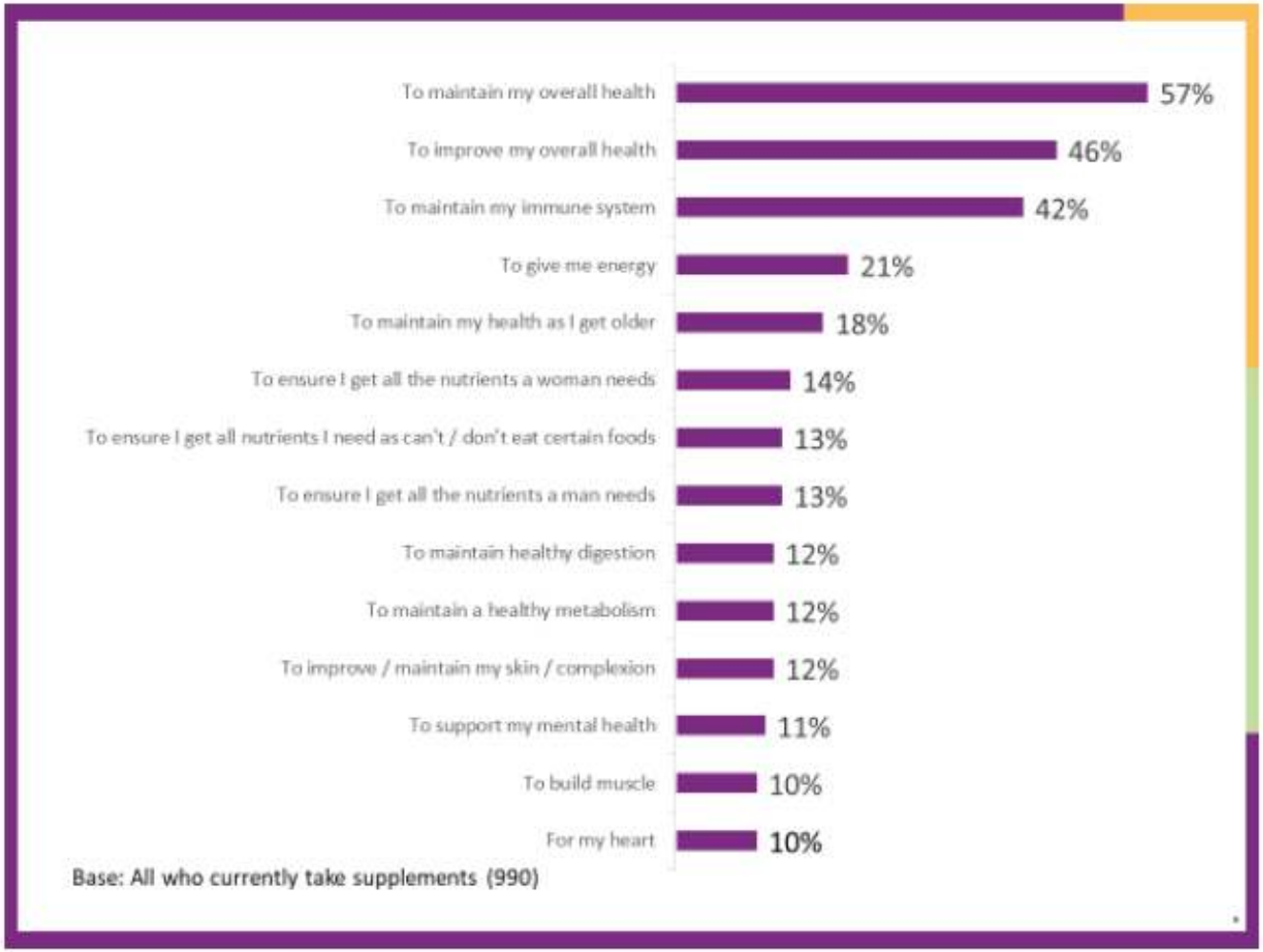
Figure 7: What do you take these [supplements] for?



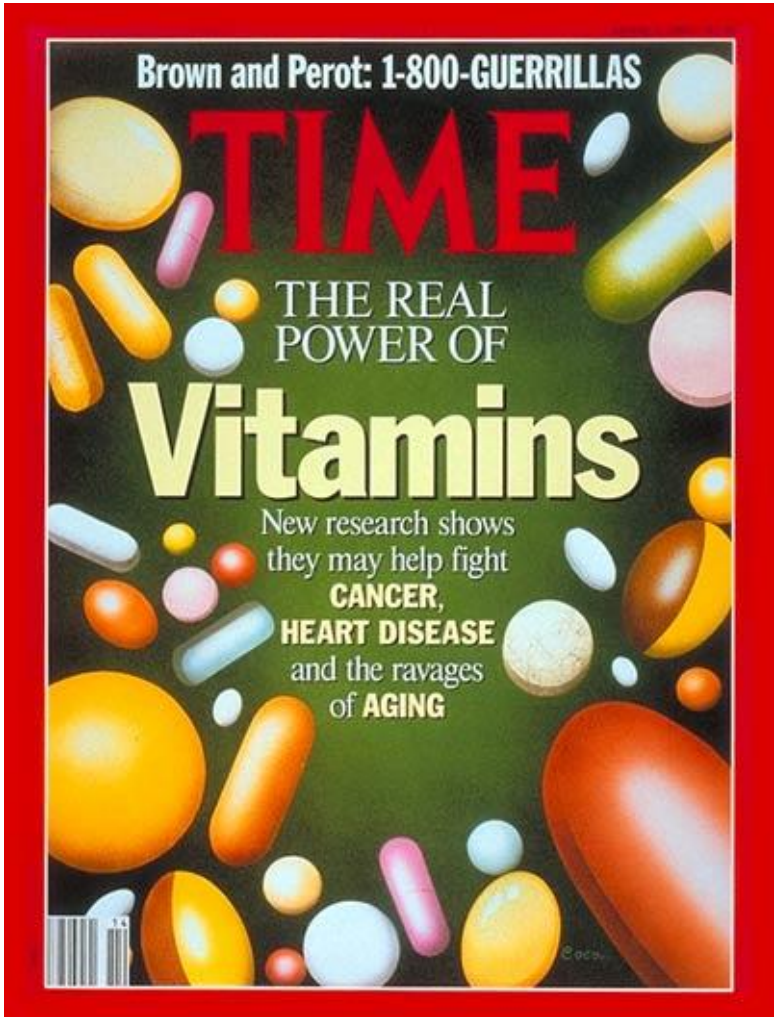
Food Supplements Consumer Research

Final Report for

Food Standards Agency
food.gov.uk

May 2018

The '90s – the promise of antioxidants….



6 Apr 1992

http://content.time.com/time/covers/0,16641,19920406,00.html

Antioxidant supplementation and CVD – 2000s

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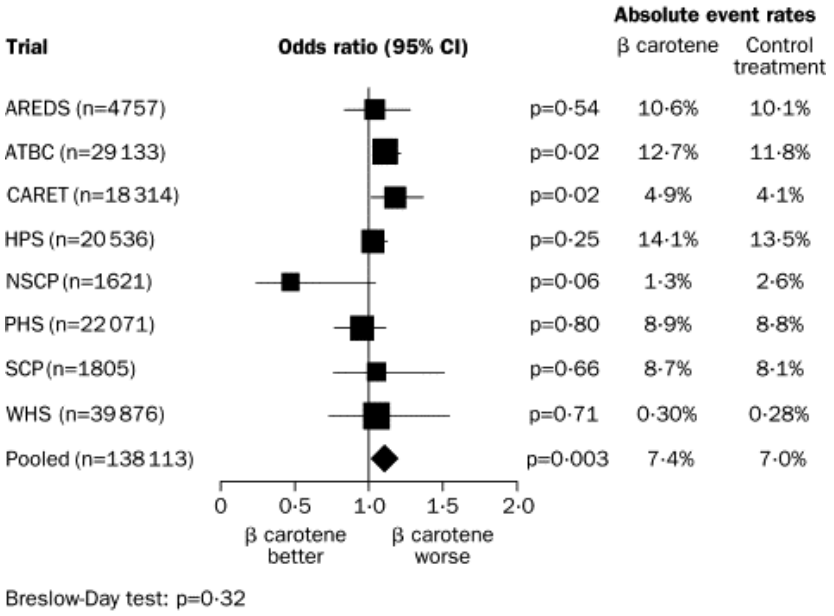
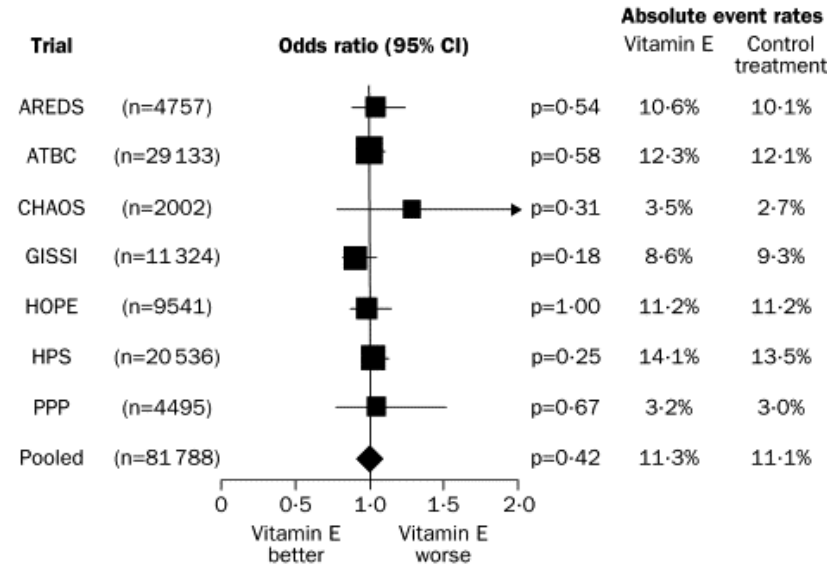


Breslow-Day test: p=0·32



Breslow-Day test: p=0·63

β-carotene

Vitamin E

No effect of antioxidant supplementation on CVD endpoints

Vivekananthan et al., 2003 Lancet. 2003 Jun 14;361(9374):2017-23. Use of antioxidant vitamins for the prevention of cardiovascular disease: meta-analysis of randomised trials.

JOURNAL OF THE AMERICAN COLLEGE OF CARDIOLOGY VOL. 71, NO. 22, 2018

SPECIAL FOCUS ISSUE: CARDIOVASCULAR HEALTH PROMOTION

THE PRESENT AND FUTURE: *JACC* STATE-OF-THE-ART REVIEW

Supplemental Vitamins and Minerals for CVD Prevention and Treatment

David J.A. Jenkins, MD, PhD, DSc,[a,b,c,d,e] J. David Spence, MD,[f] Edward L. Giovannucci, MD, ScD,[g] Young-in Kim, MD,[a,h,i] Robert Josse, MD,[a,b,e] Reinhold Vieth, PhD,[a] Sonia Blanco Mejia, MD, MSc,[a,c,d] Effie Viguiliouk, MSc,[a,c,d] Stephanie Nishi, MSc, RD,[a,d] Sandhya Sahye-Pudaruth, MPH, RD,[a,d] Melanie Paquette, MSc, RD,[a,d] Darshna Patel, BA,[a,d] Sandy Mitchell, BASc, RD,[a,d] Meaghan Kavanagh, MSc,[a,d] Tom Tsirakis, BA,[d] Lina Bachiri, BSc,[j] Atherai Maran, BSc,[d] Narmada Umatheva, BSc,[d] Taylor McKay, MSc, BScH,[d] Gelaine Trinidad, BASc,[d] Daniel Bernstein, BASc, BSc,[d] Awad Chowdhury, BSc,[d] Julieta Correa-Betanzo, PhD,[d] Gabriella Del Principe, BA,[d] Anisa Hajizadeh, BHSc,[d] Rohit Jayaraman, MD,[d] Amy Jenkins, MSc,[d] Wendy Jenkins, BSc,[d] Ruben Kalaichandran, BScH,[d] Geithayini Kirupaharan, BASc,[d] Preveena Manisekaran, BASc,[d] Tina Qutta, BASc, BCom, MBA,[d] Ramsha Shahid, BSc,[d] Alexis Silver, BASc,[d] Cleo Villegas,[d] Jessica White, BSc,[d] Cyril W.C. Kendall, PhD,[a,c,d,k] Sathish C. Pichika, MSc,[a,d,l] John L. Sievenpiper, MD, PhD[a,b,c,d,e]

JACC – state of the art review: Supplemental vitamins and minerals for CVD prevention and treatment

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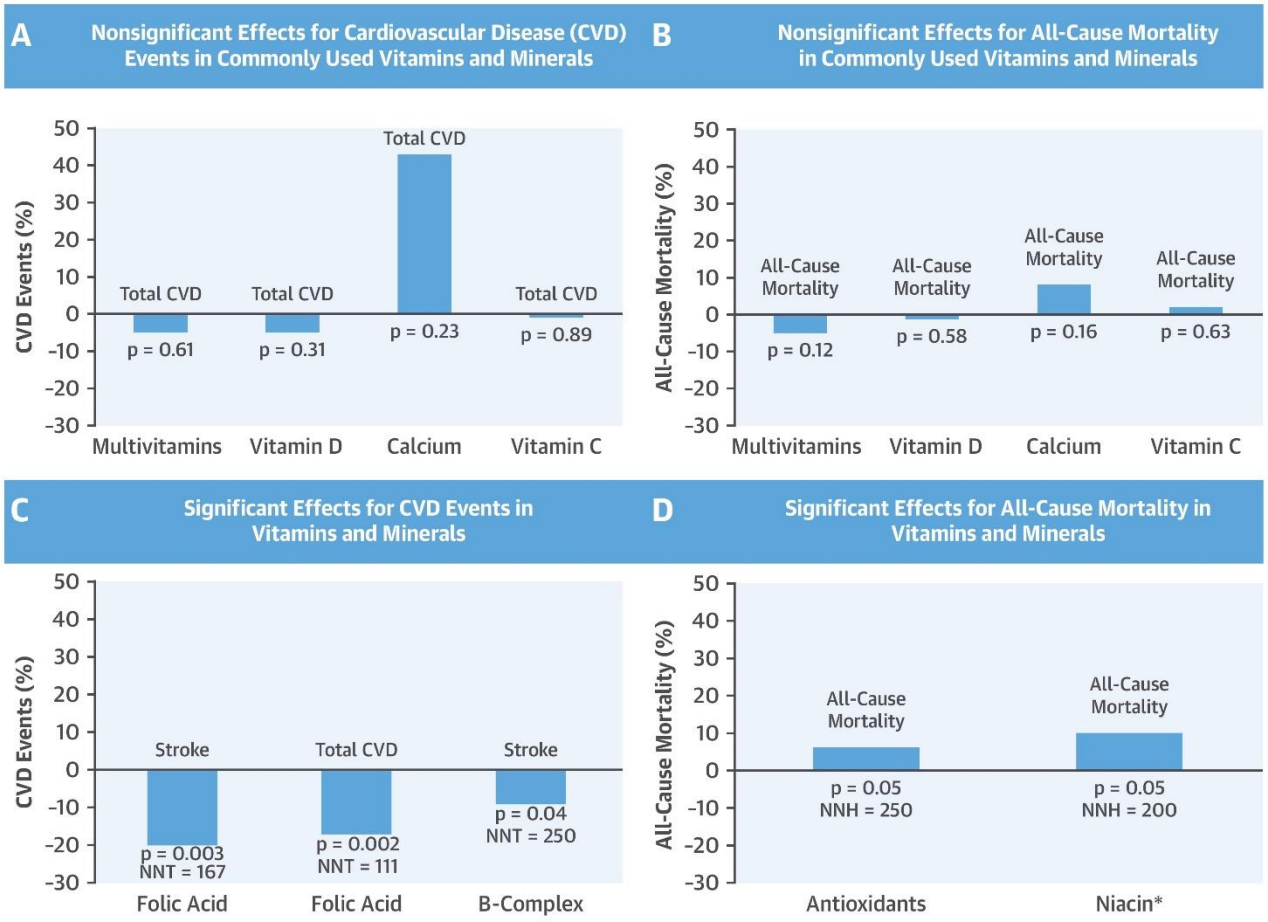
CENTRAL ILLUSTRATION: Supplemental Vitamins and Minerals: Micro-nutrient Risks and Benefits



Jenkins, D.J.A. et al. J Am Coll Cardiol. 2018;71(22):2570-84.

Why did clinical trials show no effect of antioxidant supplementation?

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Trial design	Dose Duration of treatment Initial antioxidant levels Dietary intake Extent and distribution of existing atherosclerosis
Antioxidants used	**Do single antioxidants behave differently out with the food matrix e.g. whole fruit and vegetables more effective?**
Confounding	Other lifestyle behaviours, e.g. high intake of antioxidants associated with physical activity, smoking and social class

Supplements and chronic disease – there is No magic bullet……

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"the effect on diseases with long latency periods of pharmacological doses of specific micronutrients over a few years in middle-aged adults is a different scenario from physiological doses of the same micronutrients provided as part of a balanced diet on a lifelong basis, starting in childhood."

Forman D(1), Altman D. Vitamins to prevent cancer: supplementary problems. Lancet. 2004 Oct 2-8;364(9441):1193-4.

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Mediterranean Diet Pyramid

A contemporary approach to delicious, healthy eating

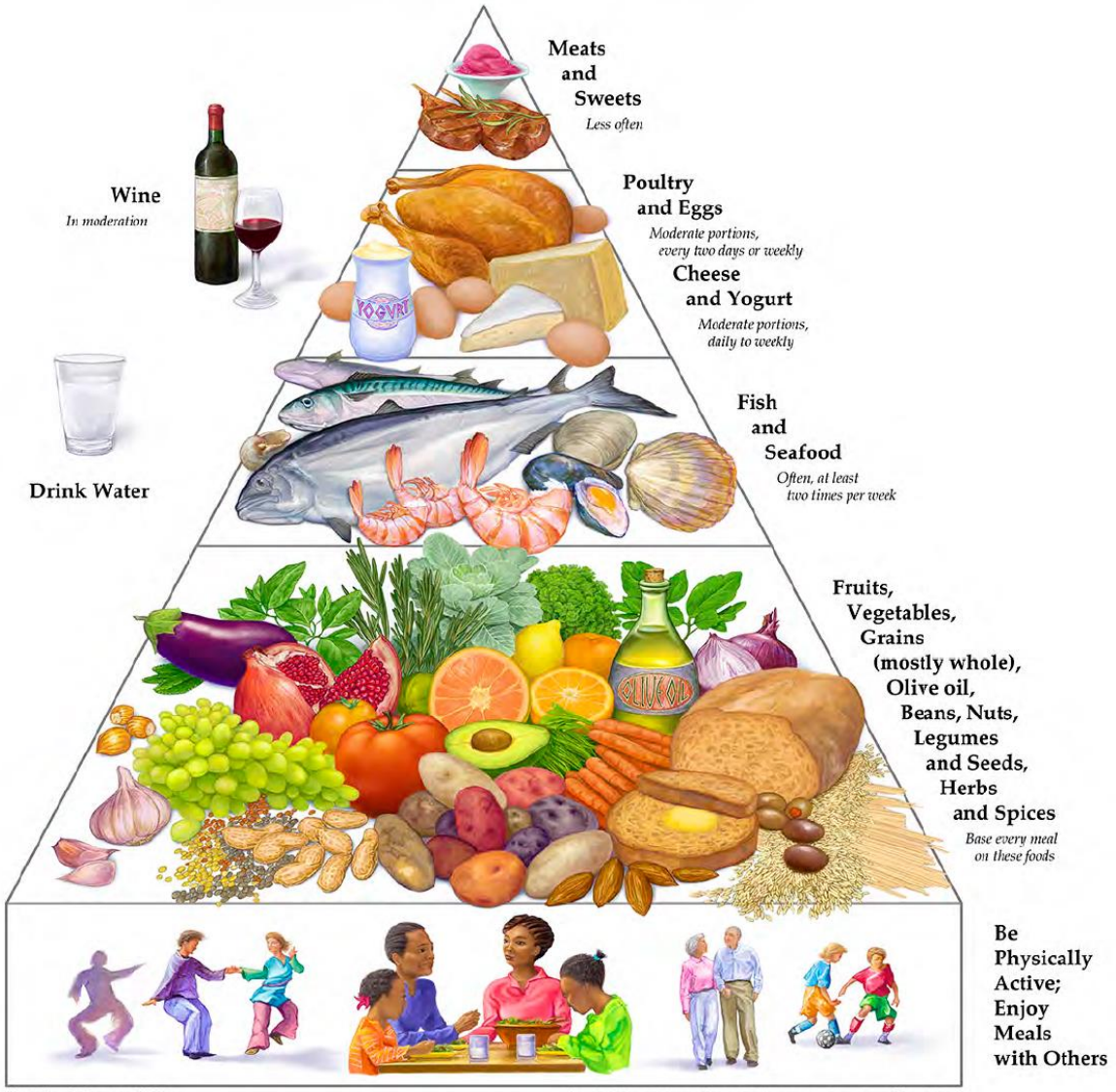
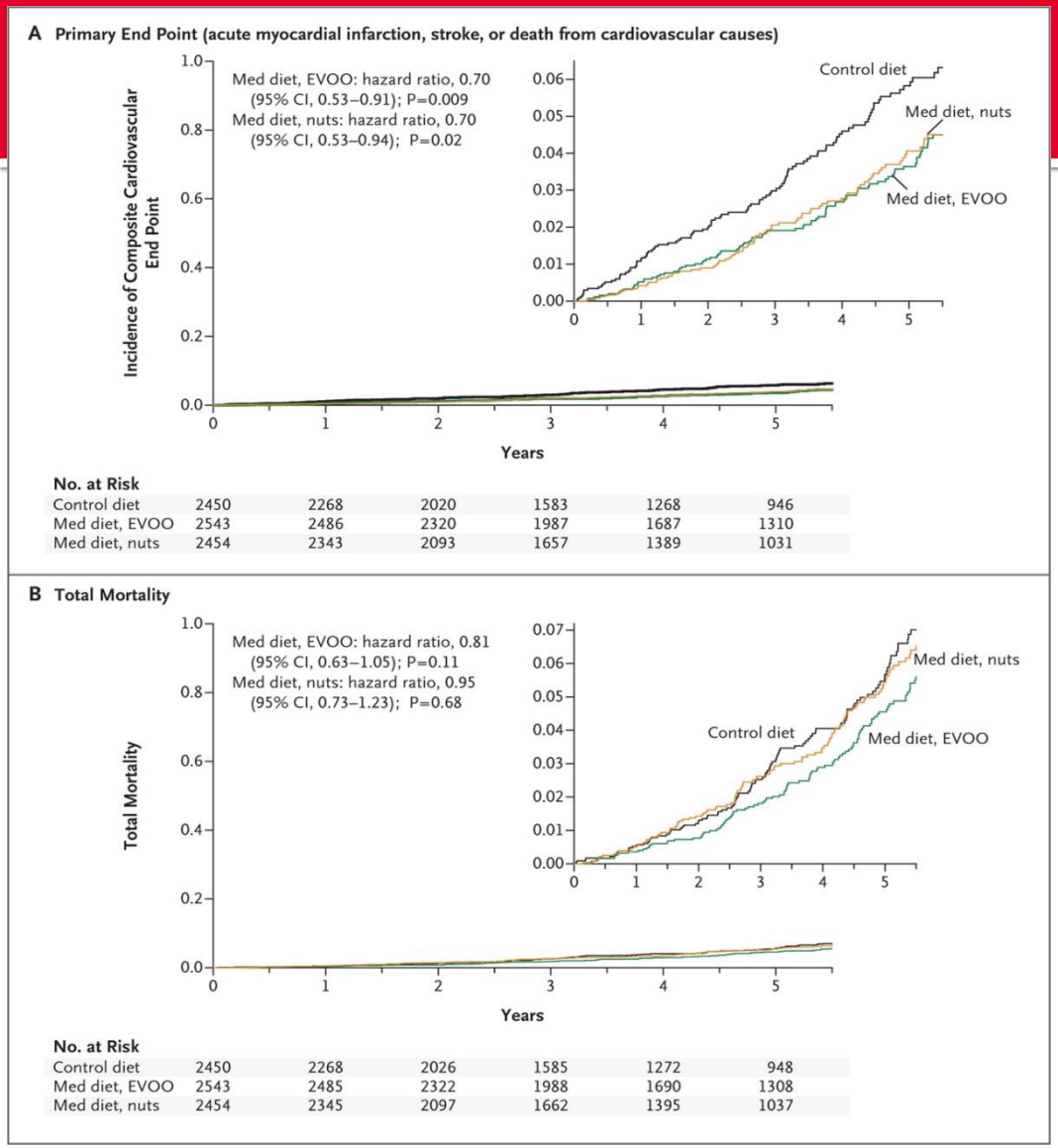


Illustration by George Middleton

 www.oldwayspt.org

PREDIMED Study (n = 7447)



Primary endpoint - acute MI, stroke or death from cardiovascular causes:

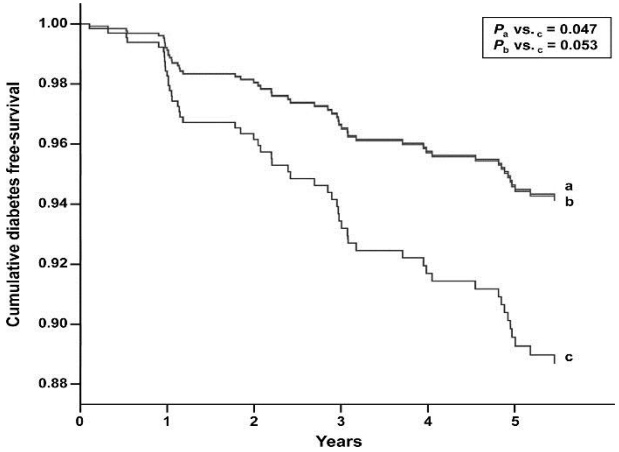
Med diet + olive oil: HR 0.70, p=0.009

Med diet + nuts: HR 0.70, p=0.02

Secondary endpoint - total mortality:

Med diet + olive oil: HR 0.81, p=0.11

Med diet + nuts: HR 0.95, p=0.68



Estruch R et al. N Engl J Med 2018

Salas-Salvadó J et al. N Engl J Med 2011

Main finding: Med Diet reduces CVD and diabetes in those at high risk of CVD

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nutrients

MDPI

Review

DASH Dietary Pattern and Cardiometabolic Outcomes: An Umbrella Review of Systematic Reviews and Meta-Analyses

Laura Chiavaroli [1,2], Effie Viguiliouk [1,2], Stephanie K Nishi [1,2], Sonia Blanco Mejia [1,2], Dario Rahelić [3,4], Hana Kahleová [5,6], Jordi Salas-Salvadó [7,8], Cyril WC Kendall [1,2,9] and John L Sievenpiper [1,2,10,11,*]

33 trial comparisons in 4479 participants on intermediate cardiometabolic risk factors. The DASH dietary pattern was associated with a reduction in the primary outcome of the prospective cohort studies, CVD incidence (20%), as well as reductions in the secondary outcomes: CHD (21%), stroke (19%), and diabetes (18%). These changes were supported by a clinically meaningful reduction in the primary outcome of the controlled trials, blood pressure (−5.2 mmHg for SBP), as well as reductions in the secondary outcomes: DBP (−2.6 mmHg), lipids (−0.1 mmol/L for LDL-C and −0.2 mmol/L for Total-C), body weight (1.42 kg), and HbA1c (−0.53%).

Consider the whole as well as the parts.....

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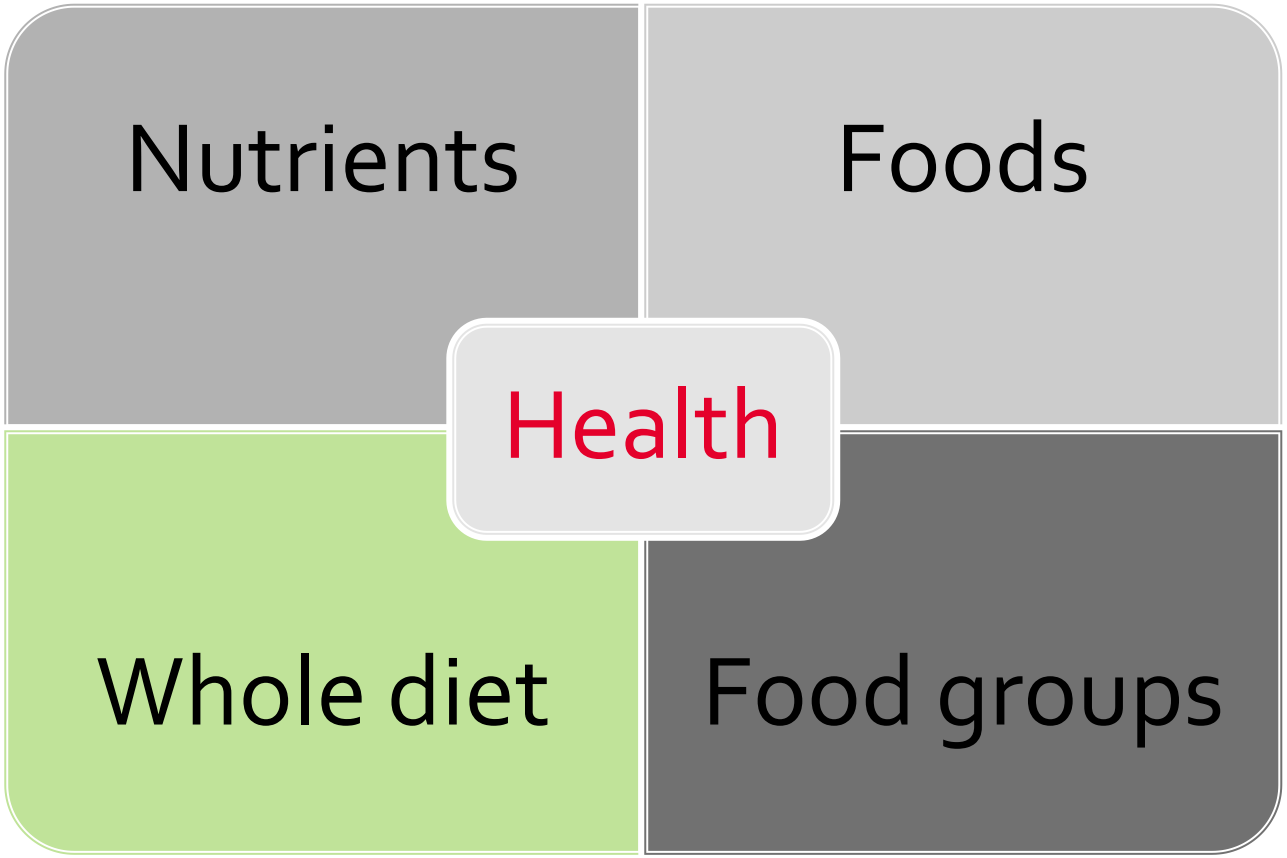
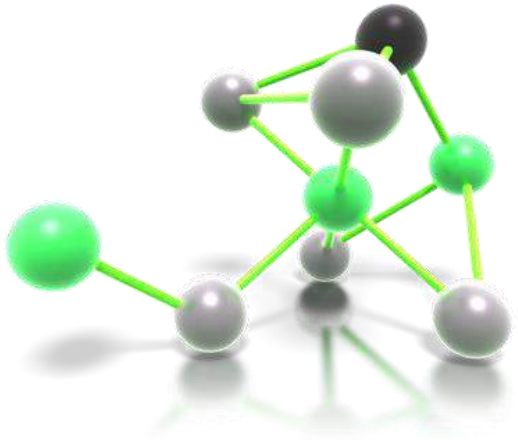


The matrix hypothesis

Dairy matrix hypothesis

The health effects of dairy foods are a function of the interaction between the physical structure of the food and the nutrient and bioactive constituents within it meaning that the whole is greater than the sum of the parts



Consider the whole as well as the parts.....

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Milk & dairy more than just calcium:

- High quality protein
- Bioactive peptides
- 400 different fatty acids
- Lactose
- > 8 Vitamins
- > 5 Minerals
- Fermented products with unique composition

A heterogeneous food group

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Milk

- Fat
- Protein

Cheese

- Bacterial cultures
- Ripening/aging
- Fat
- Protein

Yogurt

- Bacterial cultures
- Fat
- Sugar

A heterogeneous food group…….

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Milk

Protein

Cheese

Fat

Protein

Yogurt

Fat

Sugar

PLUS
- Variations in physical structure
– e.g. liquid, gel, solid……

Studying the effect of the dairy matrix

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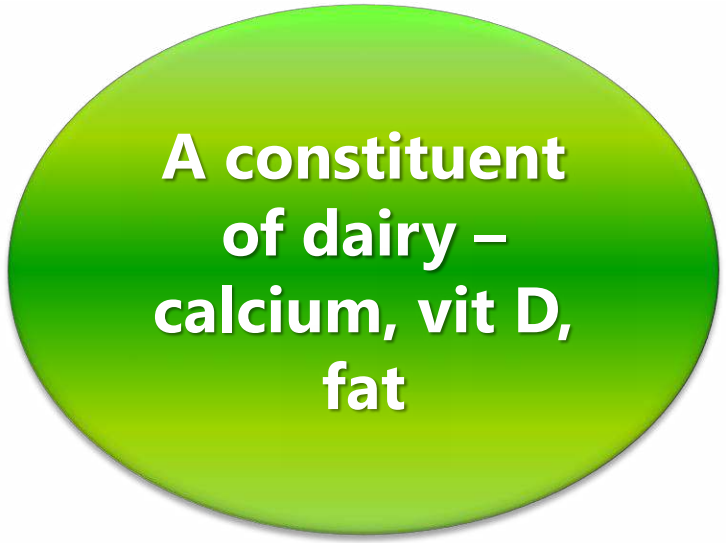

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Weight management

Dairy matrix effect - Weight

Nutrition, Metabolism & Cardiovascular Diseases (2011) 21, 499–503

available at www.sciencedirect.com

ScienceDirect

journal homepage: www.elsevier.com/locate/nmcd

Nutrition, Metabolism & Cardiovascular Diseases

Comparison of the effects of cows' milk, fortified soy milk, and calcium supplement on weight and fat loss in premenopausal overweight and obese women

Sh Faghih [a], A.R. Abadi [b], M. Hedayati [c], S.M. Kimiagar [a,*]

[a] *Department of Nutrition, Faculty of Nutrition Sciences and Food Technology, Arghavan Ave, Farahzadi Bulv, Tehran, Iran*
[b] *Department of Statistics, Faculty of Medicine, Evin, Tehran, Iran*
[c] *Obesity Research Center, Research Institute for Endocrine Sciences, Shahid Beheshti University of Medical Sciences,*

Faghih et al, 2011

- 100 healthy overweight/obese pre-menopausal women
- Randomised, 8 weeks, calorie-deficit diets:
  - Control diet – 500 kcal/d deficit
  - Calcium supplemented diet – 800 mg/d + 500kcal/d deficit
  - Milk diet – 3 servings/d + 500 Kcal/d deficit
  - Soy milk – 3 servings calcium fortified soy milk + 500 kcal/d deficit

Faghih et al, 2011

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Control	Soy milk	Ca supplement	Milk diet
2.87 ± 1.55 kg (3.8%)	3.46 ± 1.28 Kg (4.3%) (0.59 kg)	3.89 ± 2.40 kg (4.8%) (1.02 kg)	4.43± 1.93 kg (5.8%) (1.56 kg)*

- Weight reductions after 8 weeks:
- **No significant differences** in changes in body weight and BMI between the soy milk or Ca suppl & control.
- Reductions in weight and BMI were **significantly greater in the milk group compared to controls**.
- Greatest changes were seen in high dairy group - **% weight loss in milk group was significantly greater than in soy milk group and controls.**

Bone health

Dairy matrix effect - Bone

QUEEN'S UNIVERSITY BELFAST

Am J Clin Nutr 2005;82:1115–26.

See corresponding CME exam on page 1147.

Effects of calcium, dairy product, and vitamin D supplementation on bone mass accrual and body composition in 10–12-y-old girls: a 2-y randomized trial[1–3]

Sulin Cheng, Arja Lyytikäinen, Heikki Kröger, Christel Lamberg-Allardt, Markku Alén, Arvo Koistinen, Qing Ju Wang, Miia Suuriniemi, Harri Suominen, Anitta Mahonen, Patrick HF Nicholson, Kaisa K Ivaska, Riitta Korpela, Claes Ohlsson, Kalervo H Väänänen, and Frances Tylavsky

ABSTRACT

Background: Little is known about the relative effectiveness of calcium supplementation from food or pills with or without vitamin D supplementation for bone mass accrual during the rapid growth period.

Objective: The purpose was to examine the effects of both food-based and pill supplements of calcium and vitamin D on bone mass

Calcium metabolism during childhood is complex, and the degree of positive calcium balance necessary to achieve maximum peak bone mass is not known. Recent studies have shown that calcium intake and skeletal modeling determine calcium balance during growth and that childhood is a time of high calcium requirements (1, 2). Calcium supplementation intervention studies in children have shown that daily supplementation

Cheng et al, 2005

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Cheese	Ca supplement	Ca + D supplement	Placebo

- Cheese group – significantly higher percentage change in cortical thickness of tibia than placebo *or* calcium *or* calcium + vitamin D group.
- Also higher whole-body bone mineral density than placebo when compliance >50%.
- Cheese more beneficial for bone mass accrual than the use of Ca supplement.

Dairy matrix effect - Bone

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The American Journal of Clinical Nutrition

Changes in biochemical indexes of bone metabolism and bone mineral density after a 12-mo dietary intervention program: the Postmenopausal Health Study[1–3]

Yannis Manios, George Moschonis, George Trovas, and George P Lyritis

ABSTRACT

Background: In southern Europe, calcium supplementation alone is a common practice for osteoporosis prevention.

Objective: We examined whether calcium supplementation could be as effective in achieving favorable bone mass changes in postmenopausal women as is a holistic dietary approach including dairy products fortified with calcium and vitamin D_3.

Design: A sample of 101 postmenopausal women were randomly assigned to a dairy intervention group ($n = 39$) who received daily ≈1200 mg Ca and 7.5 μg vitamin D_3 via fortified dairy products and attended biweekly nutrition education sessions; a calcium-supplemented group ($n = 26$) who received a total of 1200 mg Ca/d; and a control group ($n = 36$).

Results: The increases observed in serum concentrations of insulin-like growth factor I were greater in the dairy intervention group than in the 2 other groups, especially during the first 5 mo of intervention ($P = 0.034$). The decreases and increases observed during 5 and 12 mo, respectively, in serum 25-hydroxyvitamin D_3 were significant in all groups ($P = 0.050$). Serum parathyroid hormone increased only in the control group, and serum type 1 collagen cross-linked C-telopeptide decreased only in the dairy intervention group during both 5 and 12 mo of intervention ($P = 0.035$ and 0.047, respectively). The dairy intervention group had greater improvements in pelvis ($P = 0.040$), total spine ($P = 0.001$), and total-body ($P = 0.001$) bone mineral density than did the other 2 groups.

Greece has increased significantly: from 1977 to 1992, age-adjusted incidence in Greek persons aged >50 y increased by 80.9% (2).

The adequate intake of certain nutrients that are essential for bone metabolism, such as calcium and vitamin D, plays an important role in maintaining bone mass. With increasing age, however, both dietary calcium intake and intestinal calcium absorption decrease (3). Furthermore, in the elderly, serum concentrations of 25-hydroxyvitamin D_3 [25(OH)D_3] decline, mostly because of decreased sunlight (ultraviolet B irradiation) exposure, which leads to a limited capacity for cutaneous vitamin D synthesis (4). Combined with low dietary intake of vitamin D from staple foods, especially in countries without mandatory fortification policy (5), these factors contribute to lower concentrations of 25(OH)D_3 and consequently to accelerated bone loss and greater risk of bone fracture (6, 7). It has been reported that meeting daily dietary requirements of calcium and vitamin D produces a significant reduction in the incidence of bone fracture (8, 9).

Although low bone mineral density (BMD) has been identified as one of the stronger predictors of future bone fracture, the serum concentrations of several biomarkers of bone remodeling have also been proposed as important predictors of BMD loss (10). According to recent evidence, supplementation with cal-

Manios et al, 2007

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Dairy group

Ca supplement

Control

n=101 postmenopausal women

12 months

Manios et al, 2007

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Dairy group

Ca supplement

Control

products for a period of 12 mo induced favorable changes in biochemical indexes of bone remodeling, calciotropic hormones, and pelvis, total spine, and total-body BMD. In contrast, no such favorable changes in either biochemical indexes or BMD were obtained in the CaG, the group that was supplemented only with the recommended amount of calcium. The favorable changes observed in the DG may not be attributed solely to the greater intakes of calcium and vitamin D but also to other, less studied ingredients of dairy products. Recent research has highlighted the important roles of magnesium and other micronutrients (47) and of milk protein (48) in bone metabolism. It has been suggested that the effect of dairy products on bone health may be greater than can be accounted for by any single constituent and that milk ingredients as a whole may be more effective than the sum of their individual parts (47).

Manios et al, 2005

products for a period of 12 mo induced favorable changes in biochemical indexes of bone remodeling, calciotropic hormones, and pelvis, total spine, and total-body BM consumption of fortified dairy favorable changes in either biochemical indexes or BMD were obtained in the CaG, the group that was supplemented only with the recommended amount of calcium. The favorable changes observed in the DG may not be attributed solely to the greater intakes of calcium and vitamin D but also to other, less studied ingredients of dairy products. Recent research has highlighted the important roles of magnesium and other micronutrients (47) and of milk protein (48) in bone metabolism. It has been suggested that the effect of dairy products on bone health may be greater than can be accounted for by any single constituent and that milk ingredients as a whole may be more effective than the sum of their individual parts (47).

Dairy matrix effect? – serum ionised Ca

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British Journal of Nutrition (2015), **113**, 1585–1594
doi:10.1017/S000711451500080X

Acute effects of calcium citrate with or without a meal, calcium-fortified juice and a dairy product meal on serum calcium and phosphate: a randomised cross-over trial

Sarah M. Bristow*, Gregory D. Gamble, Angela Stewart, Rama Kalluru, Anne M. Horne and Ian R. Reid
Department of Medicine, University of Auckland, Private Bag 92019, Auckland 1142, New Zealand

(Submitted 23 October 2014 – Final revision received 16 February 2015 – Accepted 18 February 2015 – First published online 8 April 2015)

Bristow et al, 2015

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Table 1. Composition of the interventions

Intervention and meal*	Serving size	Ca (mg)†
Citrate-fasting		
Calcium citrate	500 mg	500
1 h after the ingestion of calcium citrate		
Wheat bread	84 g	64
Peaches in juice	115 g	7
Total		571
Fortified-juice		
Ca-fortified fruit juice	500 ml	500
1 h after the ingestion of fortified juice		
Wheat bread	84 g	64
Peaches in juice	115 g	7
Total		571
Citrate-with-a-meal		
Calcium citrate	500 mg	500
Eggs	2 eggs	58
Ham	50 g	0
Wheat bread	42 g	32
Margarine	20 g	2
Total		592
Dairy-meal		
Milk	100 ml	128
Sweetened yogurt	125 g	158
Cheddar cheese	34 g	230
Wheat bread	84 g	64
Total		580

Bristow et al, 2015

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Ca supplement 500mg	Ca supplement + meal	Ca fortified juice	Dairy product meal

- Women, n=10, 69 years old
- Acute crossover study –
  - serum ionised and total Ca measured @ 0, 1, 2, 4 & 6hrs
- Relative to the supplement – elevation in ionised and total Ca were delayed after supplement + meal & smaller after the dairy product meal.
- "This difference might explain the difference between the cardiovascular effects of Ca supplements and those of dietary Ca."

Bristow et al, 2015

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Ca supplement 500mg	Ca supplement + meal	Ca fortified juice	Dairy product meal

- Women, n=10, 69 years old
- Acute
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were
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- "This difference might explain the difference between the cardiovascular effects of Ca supplements and those of dietary Ca."

Karkkainen et al. Am J Clin Nutr 1997;65:1726-30

Talbot et al. Osteoporosis Int 1999;10:137-42.

PROS

- Correction of nutrient deficiencies
- Prevention of deficiencies – supplemental vitamin D in wintertime
- May be specific benefits for specific groups of people – personalised nutrition
- Placebo effect

CONS

- Excessive intakes
- Safety/contamination etc
- Medication interactions
- Lack of efficacy chronic disease prevention
- Cost
- Widening health inequalities

Conclusion

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- Foods and whole dietary patterns have beneficial effects on health that aren't seen with supplements.
- Supplements cannot mimic the effects of the food matrix
- Supplements do have a role to play in correcting deficiencies and optimising nutritional status in specific circumstances, e.g. prevention of neural tube defects

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THANK YOU.