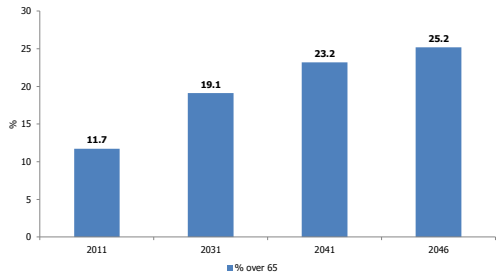
TRINITY COLLEGE DUBLIN

Dairy and the elderly: evidence to support the policies

Eamon Laird
Centre For Medical Gerontology,
Trinity College Dublin

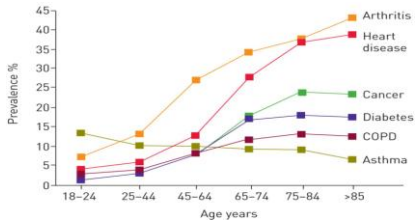
Population Age Structure Ireland, 2011-2046



Sources:
CSO Database Direct
CSO Population and Labour Force Projections 2016-2046 (M2F2 scenario)

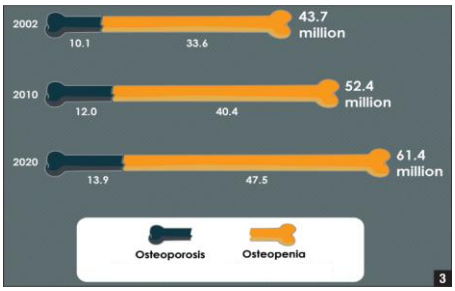
Chronic disease

With such profound shifts in population demographics, comes the corresponding rise in the frequency of age-onset chronic diseases such as Arthritis, Cardiovascular disease and Diabetes



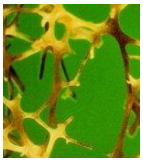
Source:
MacNee et al 2014
ERJ

Osteoporosis



Source: Shuler et al 2012 *Orthopedics*

Osteoporosis

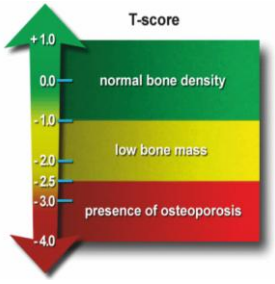


Literally translates as "porous bones"

Osteoporosis occurs when the holes between bone become bigger, making it fragile and liable to break easily

A progressive systematic skeletal disease characterized by low bone mineral density (BMD) and micro-architectural deterioration of bone tissue, with a consequent increase in bone fragility and susceptibility to fracture. The risk of condition increases with age.

Diagnosis



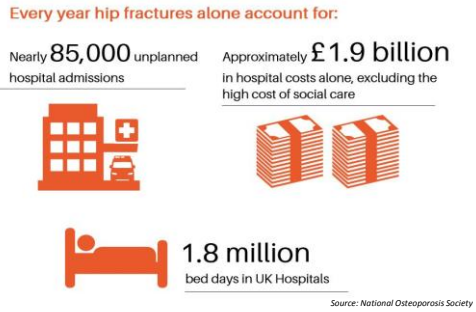
Social and economic cost

In the European Union alone osteoporosis costs €37 billion

The number of sufferers is projected to increase by 23 per cent from 27.5 million in 2010 to 33.9 million in 2025

Source: Kanis et al 2012 WHO 2012

Social and economic cost



Nutrition

Evidence suggests that adequate nutritional status is one of the factors that can delay the onset of chronic disease

Thus the improvement of diet quality in older adults could be a cost effective health strategy

Dairy and health

Consumption of dairy products has been associated with a number of positive health outcomes including:

-lower risk of hypertension,
-improved bone health
-reductions in the risk of type 2 diabetes and metabolic syndrome

Dairy-delete

- Milk (not just Cow milk!)
- Yogurt (fermented milk)
- Cheese

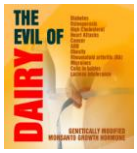
Dairy Nutrition

Considered an important provider of protein as well as vitamins and minerals including calcium, zinc, magnesium, vitamins A and D and the B-vitamins

Dairy intakes

- The National Adult Nutrition Survey (NANS) of older Irish adults (>65 yrs; n 226) the mean daily dairy intake was only 1.92 servings
- In the USA NHANES study (2005-2006), the mean daily dairy intake of milk and yogurt for all adults was just 1.02 servings

Why?



Aims

The aims of this analysis were to:

1). Detail the daily dairy intakes of milk, yogurt and cheese in older Irish adults

2). Examine how the frequency of dairy food consumption affects the blood concentration of nutrient biomarkers

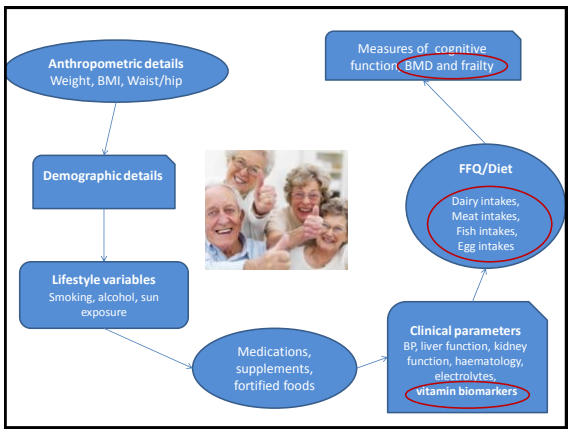
3). Investigate associations of dairy intakes with bone health

Trinity, Ulster, Department of Agriculture ageing cohort study (TUDA)

5,186 adults 60 + years

1. Hypertensive

2. Cognitive Impaired
3. Bone Clinic



Assessing Dairy intakes

Milk, yogurt and cheese total dairy intake frequency:

Questionnaire Dairy Intake Frequency	Daily Milk Serving	Daily Yogurt Serving	Daily Cheese Serving	Total Daily Dairy Serving
Twice per day	2	2	2	6
Once per day	1	1	1	3
5-6 times per week	0.785	0.785	0.785	2.355
3-4 times per week	0.5	0.5	0.5	1.5
1-2 times per week	0.21	0.21	0.21	0.63
<Once per week	0.07	0.07	0.07	0.21

Participant Characteristics: Male vs. Female

	Male (*n* 1408)	Female (*n* 2909)	*P*
Age (yrs)	72.2 (7.8)	72.8 (8.0)	0.008
BMI (kg/m²)	28.3 (4.4)	27.1 (5.7)	<0.0001
Alcohol consumer *n* (%)	921 (65.5)	1635 (56.2)	<0.0001
Current smoker *n* (%)	156 (11.1)	359 (12.3)	0.228
B12 supplement user *n* (%)	159 (11.3)	482 (16.6)	<0.0001
Folic acid supplement user *n* (%)	144 (10.4)	314 (11.4)	<0.349
B2 supplement user *n* (%)	81 (5.8)	192 (6.8)	0.178
B6 supplement user *n* (%)	78 (5.6)	196 (6.9)	0.075
D supplement user *n* (%)	449 (32.0)	1596 (55.5)	<0.0001

Values are means (±SD). Differences were assessed using an independent T-test or Chi- square where applicable

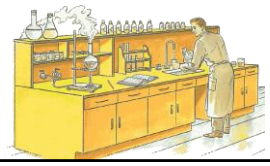
Study 1: Frequency of dairy intakes and associations with nutrition

Exclusion criteria

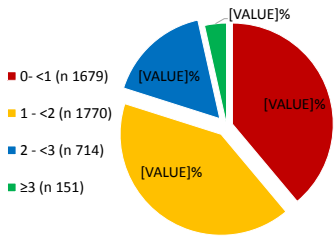
- Frailty by Physical Self-Maintenance exam score (n=3)
- Mini-Mental State Examination missing/score <25 (cognitive impairment) (n=866)
- Those on vitamin nutritional supplements

Nutritional biomarkers

- Vitamin B12 (holoTC and total cobalamin)
- Folate (serum and red cell folate (RCF))
- Vitamin B2 (EGRac in washed red cells) serum
- Vitamin B6 (PLP)
- Vitamin D (25(OH)D)

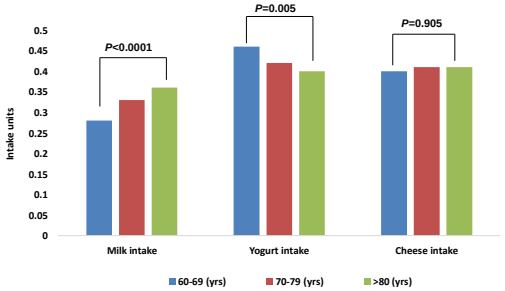


Daily dairy intake frequency

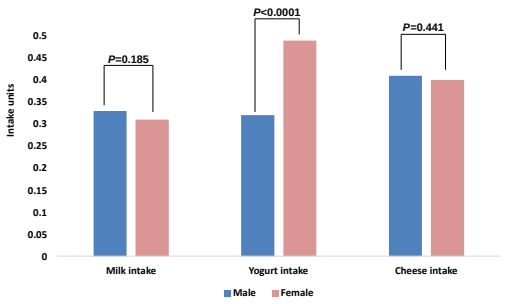


96.5% are not meeting guidelines of 3 intakes per day

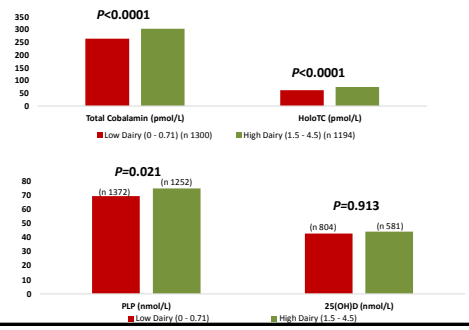
Daily dairy intakes by age



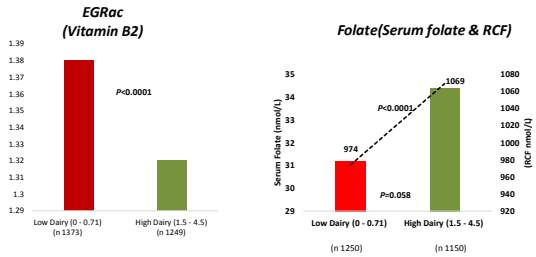
Daily dairy intakes by gender



Biomarkers of B12, B6, vitamin D



Biomarkers of vitamin B2 & Folate



Predictors of vitamin biomarker status

	Milk serving		Yogurt serving		Cheese serving	
	β	*P*-value	β	*P*-value	β	*P*-value
Total cobalamin (pmol/L)	20.64	**0.002**	24.34	**0.001**	-4.15	0.671
HoloTC (pmol/L)	4.92	**0.007**	9.67	**<0.0001**	-0.51	0.848
Serum Folate (nmol/L)	2.01	0.074	2.02	0.097	0.34	0.833
Red cell folate (nmol/L)	29.97	0.096	89.63	**<0.0001**	-22.59	0.385
Vitamin B2	-0.02	**0.001**	-0.04	**<0.0001**	-0.01	0.809
Vitamin B6 (nmol/L)	-4.45	**0.012**	8.08	**<0.0001**	0.008	0.988
Vitamin D (nmol/L)	-0.26	0.809	2.58	**0.028**	-0.78	0.61

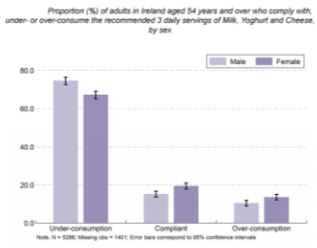
Hierarchical multiple regression analysis (supplements removed for each biomarker of interest) with adjustment for age, gender, BMI, smoking status, alcohol consumption, total daily frequency of meat (red meat and poultry), total daily frequency of fish (white and oily) and daily frequency of eggs.

How do these dairy intakes compare?

- TUDA: 1.16 servings/day
- NANS :1.92 servings/day
- NHANES: 1.02 servings/day

How do these dairy intakes compare?

The Irish Longitudinal Study on Ageing (TILDA): Nationally representative sample of >8000 older Irish adults (>50 yrs) (Wave 3 -2015)



Mean consumption:
2.1 servings/day

Dairy: Important source of micronutrients

- Vitamin B6: Important for amino-acid and neurotransmitter synthesis
- Riboflavin: Blood pressure & iron metabolism
- Folate: DNA replication & healthy ageing
- Vitamin D: Bone health & inflammation

Study 2: Dairy intakes and associations with bone health

Exclusion criteria

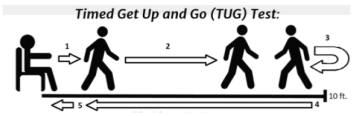
- Frailty by Physical Self-Maintenance exam score (n=3)
- Mini-Mental State Examination missing/score <25 (cognitive impairment) (n=866)
- Those without BMD measures &/or receiving bone medications/treatment

Bone measures

- Total Hip, Femoral neck & Vertebral BMD
- Vitamin D & parathyroid hormone
- Bone formation markers:
  - *Osteocalcin (OC)*
  - *Bone-specific alkaline phosphatase (BAP)*
- Bone resorption markers:
  - Collagen type 1 cross-linked c-telopeptide (CTX)
  - Tartrate-resistant acid phosphatase 5b (TRAP 5b)

Measures of physical function

- Timed up and Go (TUG)



Composite measure of functional mobility with worse scores associated with poorer muscle strength and balance, both of which are risk factors for falling in older adults

- Physical self-maintenance exam (PSM)
- Instrumental activities of daily living (IADL)

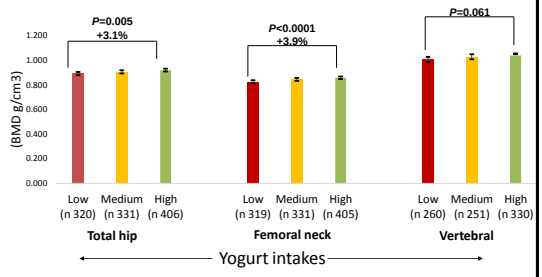
Tertiles of dairy intake

- **Low**: None to <once per week
- **Medium**: >once per week to 2-3 times per week
- **High**: >once per day or more

Results -All

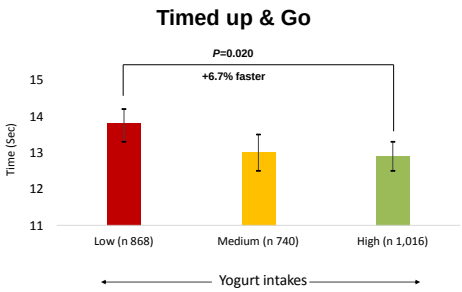
- No significant differences in BMD or bone biomarkers across intakes of milk or cheese

Yogurt and BMD : Females



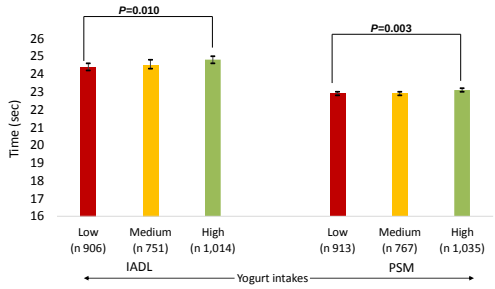
Adjustment for age, education, BMI, GFR, physical activity, total daily frequency of milk and cheese, calcium &/or vitamin D supplements.

Yogurt and functionality: Females



Adjustment for age, education, BMI, total daily frequency of milk and cheese

Yogurt and functionality: Females



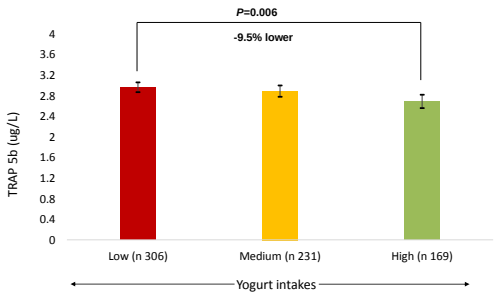
Adjustment for age, education, BMI, total daily frequency of milk and cheese

Yogurt and BMD : Males

- No significant difference across tertiles for total hip or femoral neck BMD
- Vertebral BMD was 4.1% higher in low yogurt consumers compared with non-consumers (*P*=0.028)

Adjustment for age, education, BMI, GFR, physical activity, total daily frequency of milk and cheese, calcium &/or vitamin D supplements.

Yogurt and Bone resorption : Males



Adjustment for age, education, BMI, GFR, physical activity, total daily frequency of milk and cheese, calcium &/or vitamin D supplements.

Predictors of bone health

For females: each unit increase in yogurt intake=

31% lower risk of having osteopenia (OR 0.69; 95% CI 0.49 – 0.96; *P*=0.032)

39% lower risk of being characterized as osteoporotic (OR 0.61; 95% CI 0.42 - 0.89; *P*=0.012)

Multinominal regression analysis with adjustment for: age, gender, education, BMI, smoking status, alcohol consumption, vitamin D or calcium supplement use, 25(OH)D, GFR, physical activity, total daily serving milk (glass only), total daily serving of cheese, total daily serving of meat (red meat and poultry), total daily serving of fish (white and oily) and total daily serving of eggs. (Participants receiving medications that could affect bone metabolism were removed from the analysis).

Predictors of bone health

For males: each unit increase in yogurt intake=

52% lower risk of osteoporosis (OR 0.48; 95% CI 0.24 - 0.96; *P*=0.038)

Multinominal regression analysis with adjustment for: age, gender, education, BMI, smoking status, alcohol consumption, vitamin D or calcium supplement use, 25(OH)D, GFR, physical activity, total daily serving milk (glass only), total daily serving of cheese, total daily serving of meat (red meat and poultry), total daily serving of fish (white and oily) and total daily serving of eggs. (Participants receiving medications that could affect bone metabolism were removed from the analysis).

How do these compare?

- In 2,733 adults (26-85 yrs), higher yogurt intake was positively associated with trochanteric BMD over a 12-year follow-up with a protective trend of yogurt on the risk of hip fracture. (Framingham Offspring observational study)
- In 61,000 Swedish women (aged 39-74 yrs), for each increase in yogurt intakes, hip fractures were reduced by 10-15% over a mean follow-up of 20 years

How do these compare?

- In 1,871 community dwelling older adults, higher consumption of yogurt (and milk) was associated with a lower risk of frailty and a lower risk of a slow walking speed
- Cross-sectional study of elderly Australian women (n 1,456), higher dairy intake was associated with increased grip strength and decreased likelihood of a lower TUG score

What does this mean?

- The effect of increased yogurt intake has the potential to reduce non-vertebral fractures by up to 46% in women, as fracture risk reduction has been modelled as 46% decrease for 3% hip BMD increase (based on medications)
- Possible cheap effective way of increasing BMD and reducing frailty

However……..

- Is yogurt a measure of healthy lifestyle?
- Is it the vitamins/probiotics or both/neither?
- Low fat yogurts can contain sugar!
- Further longitudinal studies (TUDA/TILDA) & RCTs greatly needed

Summary

- **>96% of those sampled did not reach the recommended guideline intake of three servings of dairy per day**
- **Dairy intake patterns were significantly affected by age and gender**
- **Milk and yogurt intakes were significant predictors of vitamin biomarker concentrations**
- **Cheese intakes unaffected by age or gender – possible under-utilized resource vehicle for the delivery of micronutrients through fortification**

Summary

- **Yogurt intakes associated with a higher BMD & reduced risk of frailty in older women**
- **Yogurt intakes were associated with lower risk of osteoporosis in both men & women**
- **Potential for cheap, effective dietary approach to reduce risk of poor bone health – more research needed!**

Trinity College Dublin
Coláiste na Tríonóide, Baile Átha Cliath
The University of Dublin

ST. JAMES'S HOSPITAL

Ulster University

- Anne Molloy
- Conal Cunningham
- Miriam Casey
- Kevin McCarroll
- Martin Healy
- Sinead McNiffe
- Helen Toohey
- Regina Dempsey
- Karen Creevey
- Tracey Claxton

- Clare O'Donovan
- Michelle Clarke
- Catherine McGarel
- Niamh Aspell
- Helena Gibbons
- Joyce Earlie

- JJ Strain
- Helene McNulty
- Mary Ward
- Leane Hoey
- Geraldine Horigan
- Shauna Harte
- Paula Tighe
- Liadhan McAnena
- Julie Sittlington
- Catherine Hughes
- Adrian McCann

This research was funded by the Irish Department of Agriculture, Food and the Marine through the grants 07FHRIUCD1 ("JINGO" 2007-2013) and 13F407 ("JINGO-JPI"/"ENPADASI" 2014-2016) and from the Northern Ireland Department for Employment and Learning (DEL), Cross-Border Research and Development Programme: "Strengthening the all Island Research Base". Funding was also provided from The National Dairy Council (NDC) Ireland

Department for Employment and Learning www.delni.gov.uk

Department of Agriculture, Fisheries and Food An Roinn Talmhaíochta, Iascaigh agus Bia

THE NATIONAL DAIRY COUNCIL

Predictors of BMD and functionality

- For females each increase in yogurt intake=

(i) Total hip BMD increase of 0.024 g/cm^2
(ii) Femoral neck BMD increase of 0.031 g/cm^2
(iii) Vertebral BMD increase of 0.034 g/cm^2

(iv) Decrease in TUG of 0.64 sec
(v) Increase in PSM of 0.15 units
(vi) Increase in IADL of 0.27 units

Regression analysis with adjustment for: age, gender, education, BMI, smoking status, alcohol consumption, vitamin D or calcium supplement use, 25(OH)D, GFR, physical activity, total daily serving milk (glass only), total daily serving of cheese, total daily serving of meat (red meat and poultry), total daily serving of fish (white and oily) and total daily serving of eggs. (Participants receiving medications that could affect bone metabolism were removed from the analysis).

Predictors of BMD markers

For males each increase in yogurt intake=

(i) Decrease in TRAP5b concentrations of 0.29 ug/L

Regression analysis with adjustment for: age, gender, education, BMI, smoking status, alcohol consumption, vitamin D or calcium supplement use, 25(OH)D, GFR, physical activity, total daily serving milk (glass only), total daily serving of cheese, total daily serving of meat (red meat and poultry), total daily serving of fish (white and oily) and total daily serving of eggs. (Participants receiving medications that could affect bone metabolism were removed from the analysis).