

# Eat your way to Better Bones - more than vitamin D

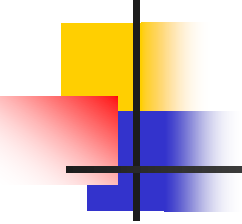
TUDA BONE COHORT

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**Dr Miriam Casey**

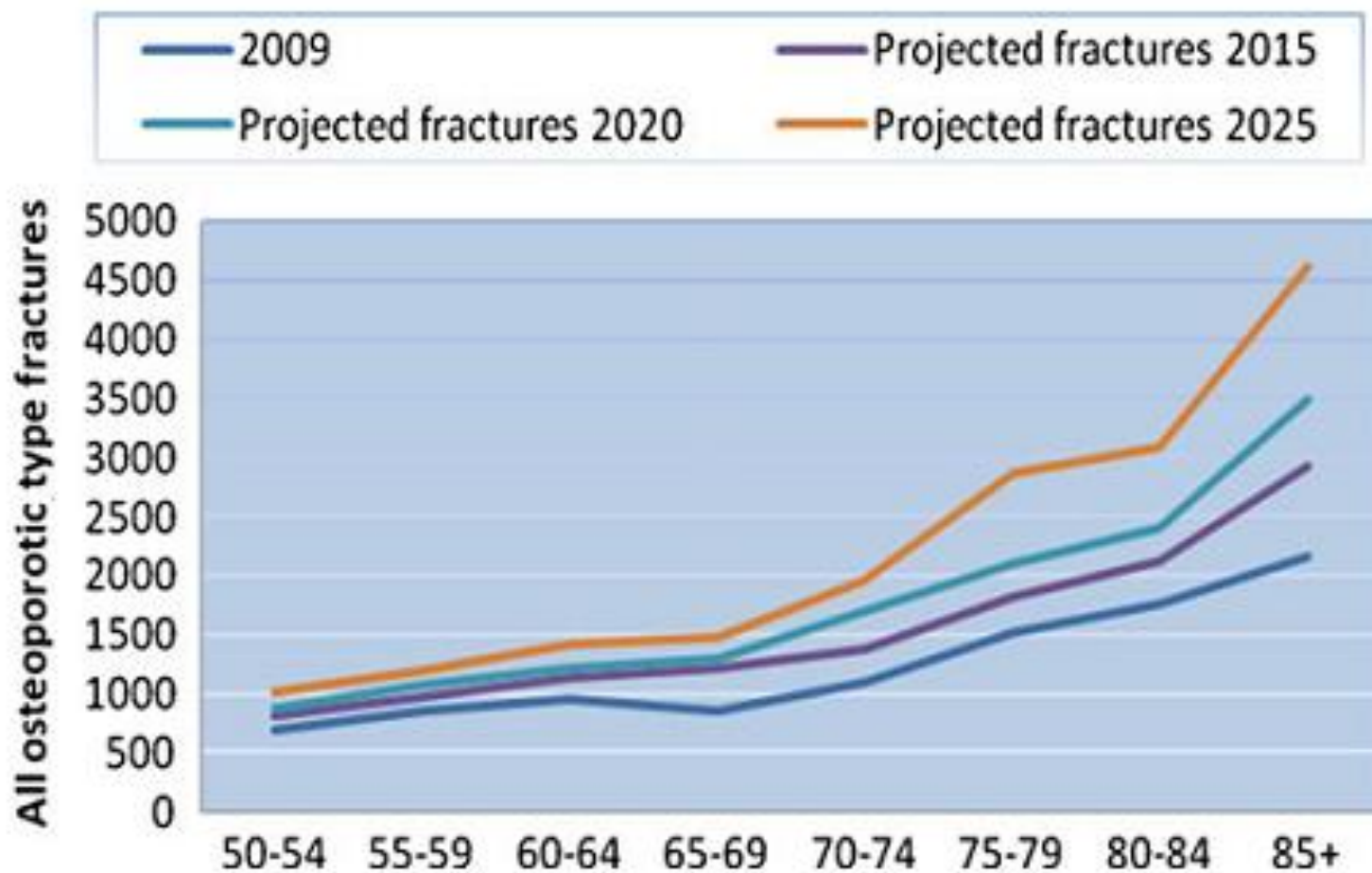
Consultant Physician and Geriatrician  
St James Hospital Dublin



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- Osteoporosis estimated to affect **over 200 million people** worldwide
  - Osteoporosis increases the risk of fractures, increased mortality, increased morbidity, losses in health-related quality of life
  - In daily practice non-compliance is a significant problem with calcium and vitamin D supplementation (**approx 50%**)
  - This provides a rationale for supporting a more **food-oriented** preventive approach of osteoporosis.

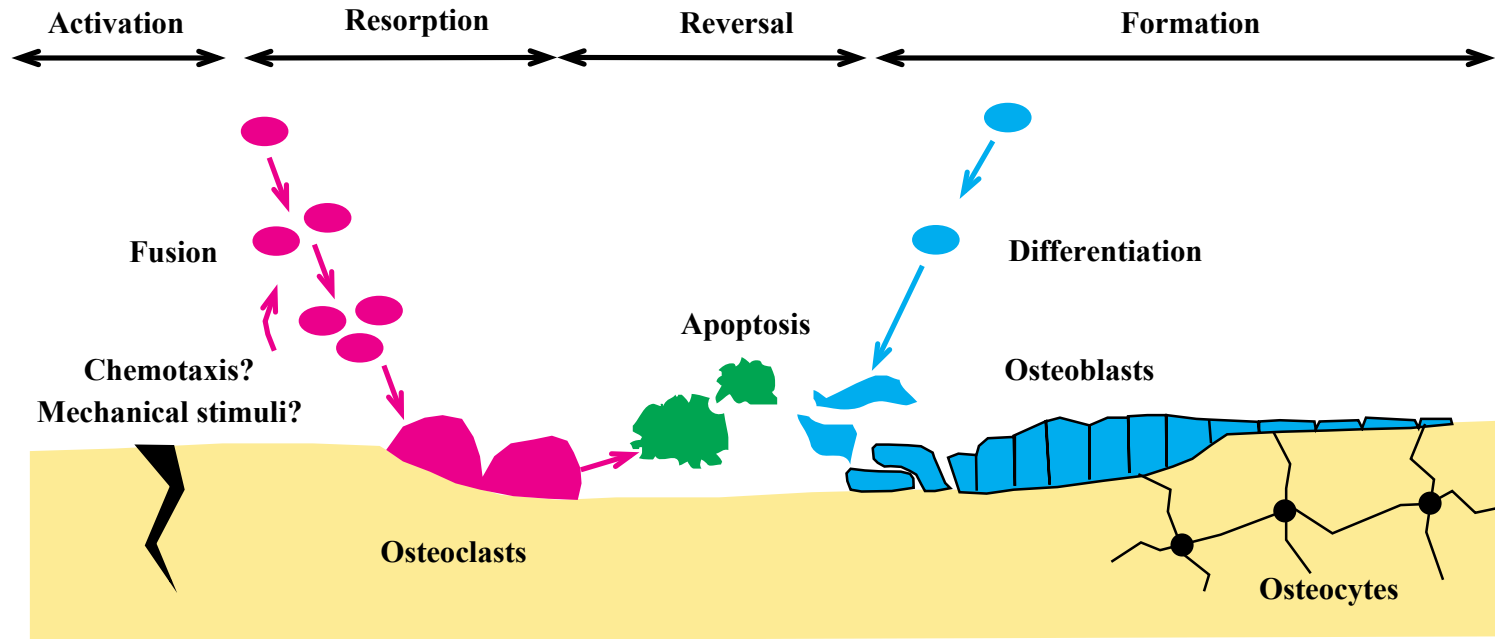
# Hospitalisations for fracture and associated costs between 2000 and 2009 in Ireland: a trend analysis

*B McGowan, M C Casey et al, Osteoporos Int 2012*



**Fig. 2** Projection of future numbers of all osteoporotic-type fractures in Ireland from 2009 to 2025

# Bone Formation and Resorption



**USE SATURATED AND TRANS FAT, SUGAR AND SALT SPARINGLY**

Saturated and *Trans* Fats = •  
Added Sugar = ^  
Salt = \*

**CALCIUM, VITAMIN D, VITAMIN B-12 SUPPLEMENTS**

*Not all people need these supplements, check with your healthcare provider*

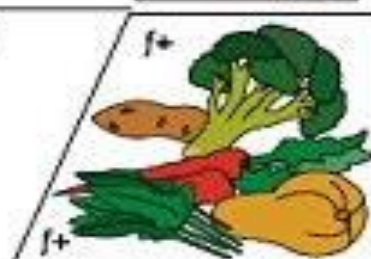
**LOW- AND NONFAT DAIRY PRODUCTS  
3 OR MORE SERVINGS**



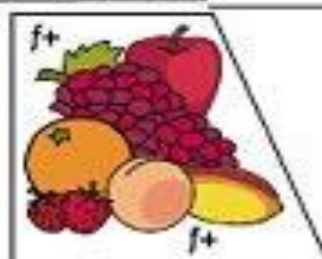
**DRY BEANS AND NUTS, FISH, POULTRY, LEAN MEAT, EGGS  
2 OR MORE SERVINGS**



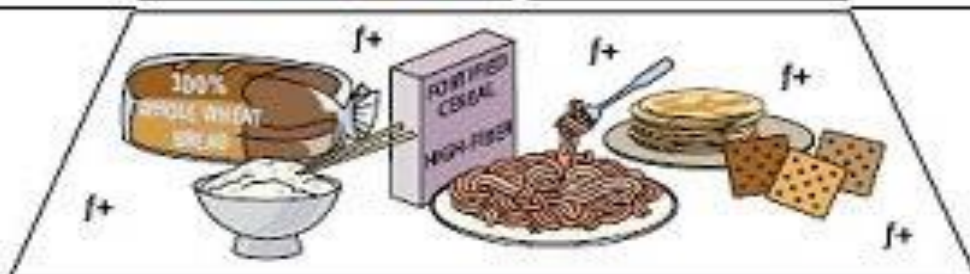
**BRIGHT-COLORED VEGETABLES  
3 OR MORE SERVINGS**



**DEEP-COLORED FRUIT  
2 OR MORE SERVINGS**



**WHOLE, ENRICHED AND FORTIFIED GRAINS AND CEREALS  
6 OR MORE SERVINGS**



*Choose whole grains and fortified foods such as brown rice, 100% whole-wheat bread, and bran cereals*

**WATER/LIQUIDS  
8 OR MORE SERVINGS**

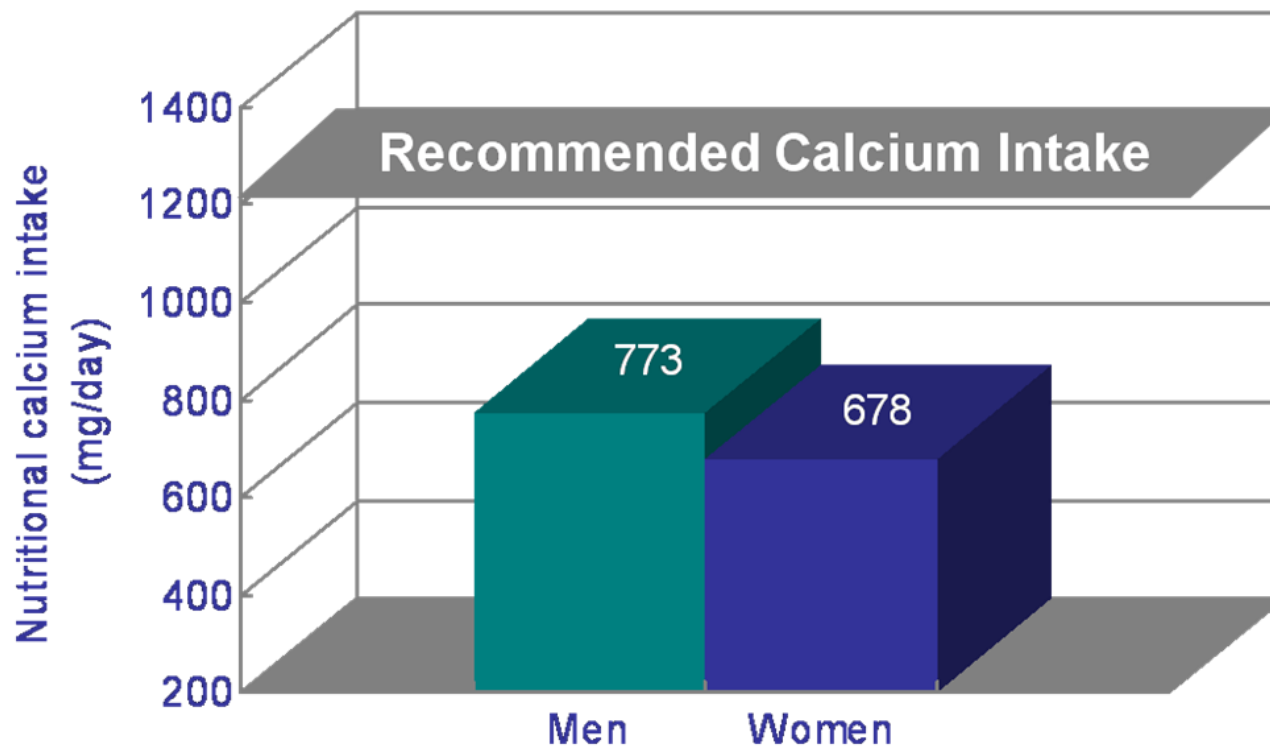


*Choose water, fruit or vegetable juice, low- and nonfat milk, or soup*

f+ High-fiber choices

# Calcium Nutrition is Poor in the Elderly

Dietary calcium intake in Americans aged 60-74  
(NHANES 1999-2000)





# 1,200mg Calcium /Day (IOF)

Breakfast	Semi skimmed milk(100mls)	215mg
	50g Muesli 30ml milk in Tea /coffee	
Mid am	Low fat <b>Yoghurt</b> (125g)	<b>175mg</b>
Lunch	<b>Cheese (30g)</b> in sandwich OR Tinned salmon (100g)  watercress salad (50g)	cheddar ( <b>220mg</b> )  Wholemeal bread – 2 slices (200mg) 90mg
Dinner	Include kale (100g) /Okra (100g) /Baked beans  <b>Glass Of milk</b>	150mg 220mg 53mg  <b>240mg</b>
Dessert	Rice Pudding / Ice Cream (100g)	100mg





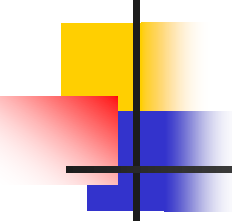
NHANES III : 14,000 Total hip BMD measured

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Divided into tertiles based on **Milk** intake :

→ Lowest tertile had lowest HIP BMD (m+fm)





Vitamin D levels, physical activity and fractures in the prospective  
OPRA Study of Elderly Women

	25(OH)D	25(OH)D	
	<50 nmol/L <i>n</i> =43	>50 nmol/l <i>n</i> =943	<i>P</i>
<b>Hours outdoors/day</b>	1.9±1.2	2.8±1.3	<0.001
<b>Activity level (1–8) <sup>a</sup></b>	4.8±1.6	5.7±1.0	<0.001
<b>Fractures</b>	9 (21%)	110 (12%)	0.039



## The Relationship between Dietary protein and BMD

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- Longitudinal Studies:

**Framingham Osteoporosis Study** Significant increases in BMD 855 older subjects followed for 4 years

Beneficial effect noted when total protein intake exceeds:

**1gm/kg/day**

Recommended Protein intake for Elderly female weight  
66kg@1gm/kg/day      Approximately 66g protein



Breast Chicken - 24g



Glass of milk- 6g



Tuna sandwich - 13g



Handful nuts - 10g



Egg -7g



Yoghurt - 6g



# Relationship between Dietary Protein and Fractures

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- Ramirez 2012  
Observational study elderly > 65y with OP fractures +controls  
  
Higher Animal protein intake in controls ( $p < 0.04$ )  
  
↓ Fracture Risk when Animal/vegetable ratio > 1.2  
greatest when ratio > 3.0
- IOWA study fm aged 55 - 69 followed for 104, 000 person years  
  
↓ RR of hip fracture across increasing quartiles of Animal protein  
Highest Quartile RR 0.31 , p for trend 0.037

Osteoporos Int (2013) 24:139–150  
DOI 10.1007/s00198-012-1998-6

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ORIGINAL ARTICLE

## **Dairy foods and osteoporosis: an example of assessing the health-economic impact of food products**

**F. J. B. Lötters • I. Lenoir-Wijnkoop • P. Fardellone •  
R. Rizzoli • E. Rocher • M. J. Poley**



## Dairy foods and osteoporosis: *Lotters et al Osteoporos Int (2013) 24:139–150*

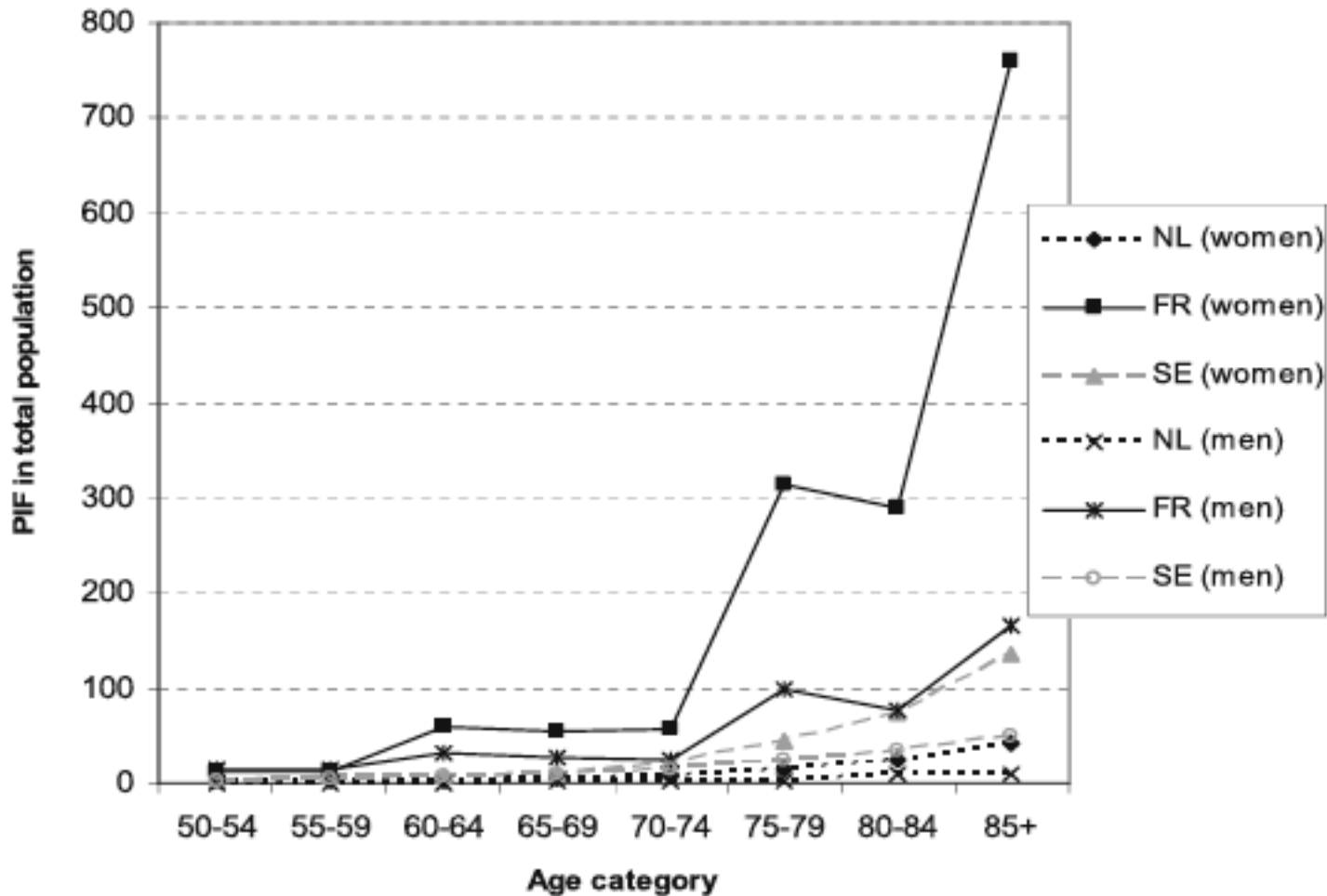
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- Constructed a model that generated the number of hip fractures that potentially can be prevented with increased dairy foods intakes,
- costs avoided
- costs of additional dairy foods ( 1 glass of milk , 1 yoghurt, 30 grams cheddar),
- number of disability-adjusted life years (DALYs) lost due to hip fractures associated with low nutritional calcium intake
- *France, Sweden and the Netherlands*

Parameter	Netherlands	France	Sweden
% low Ca intake (<600mg)	8%	40%	31%
Rec intake of Ca in elderly / day	1,300mg	1,300mg	1,300mg
Incidence of hip fractures (per 1,000 > 50 yrs)	54	35	65
Size of the general Population	5.6 million	21.7million	3.4 million
Relationship between ↓Ca intake and hip fractures RR (95% CI)	1.08 (1.02-1.16)	1.08 (1.02-1.16)	1.08 (1.02-1.16)
Cost of hip fractures First Yr after fx Subsequent yrs	€129k €23k	€115k €50k	114K €51k
Daily Cost of Dairy foods-intervention	€0.44	€0.64	€0.68

# Potential Impact Fraction

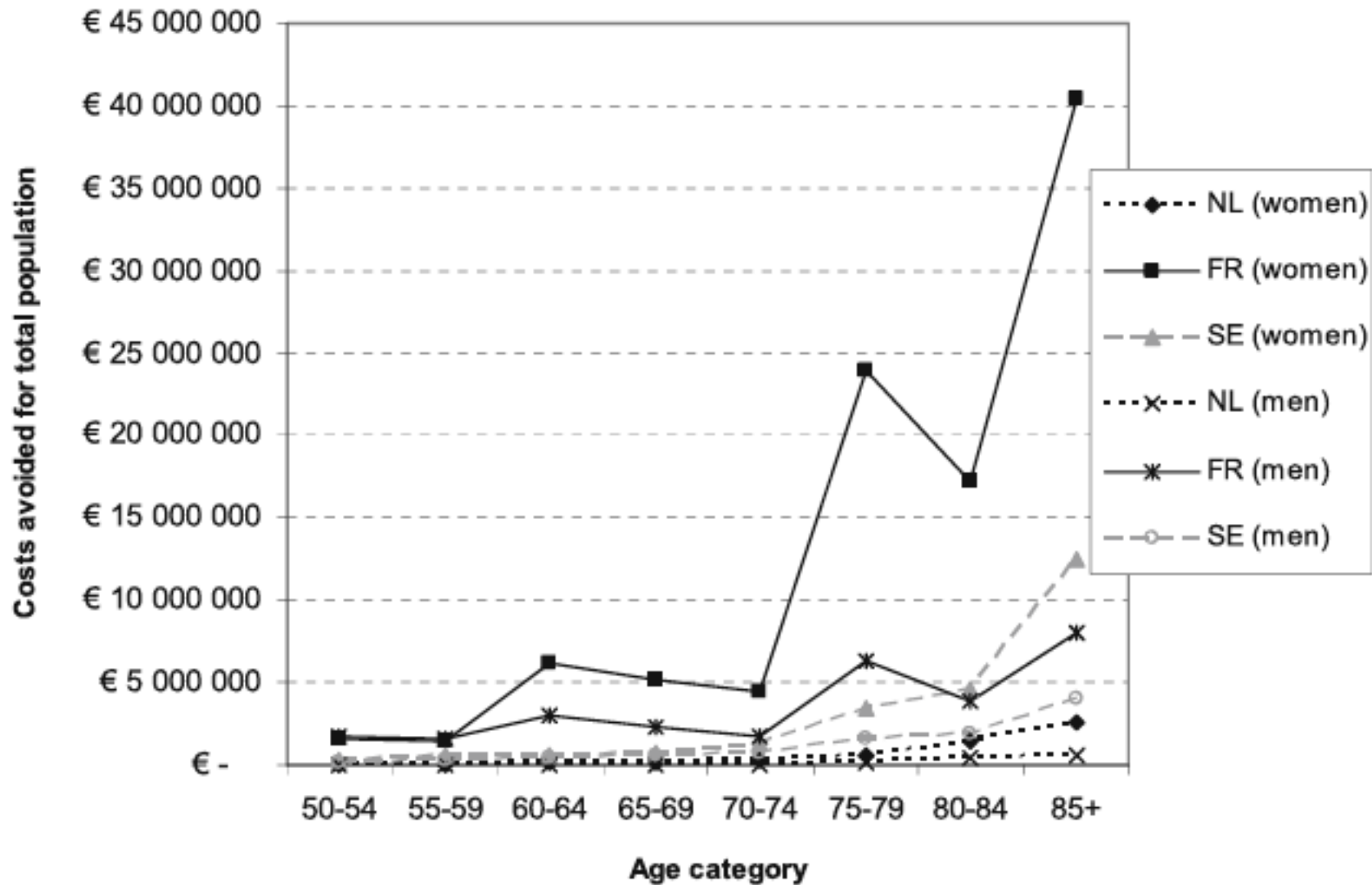
the absolute amount of hip fractures prevented with additional calcium intake



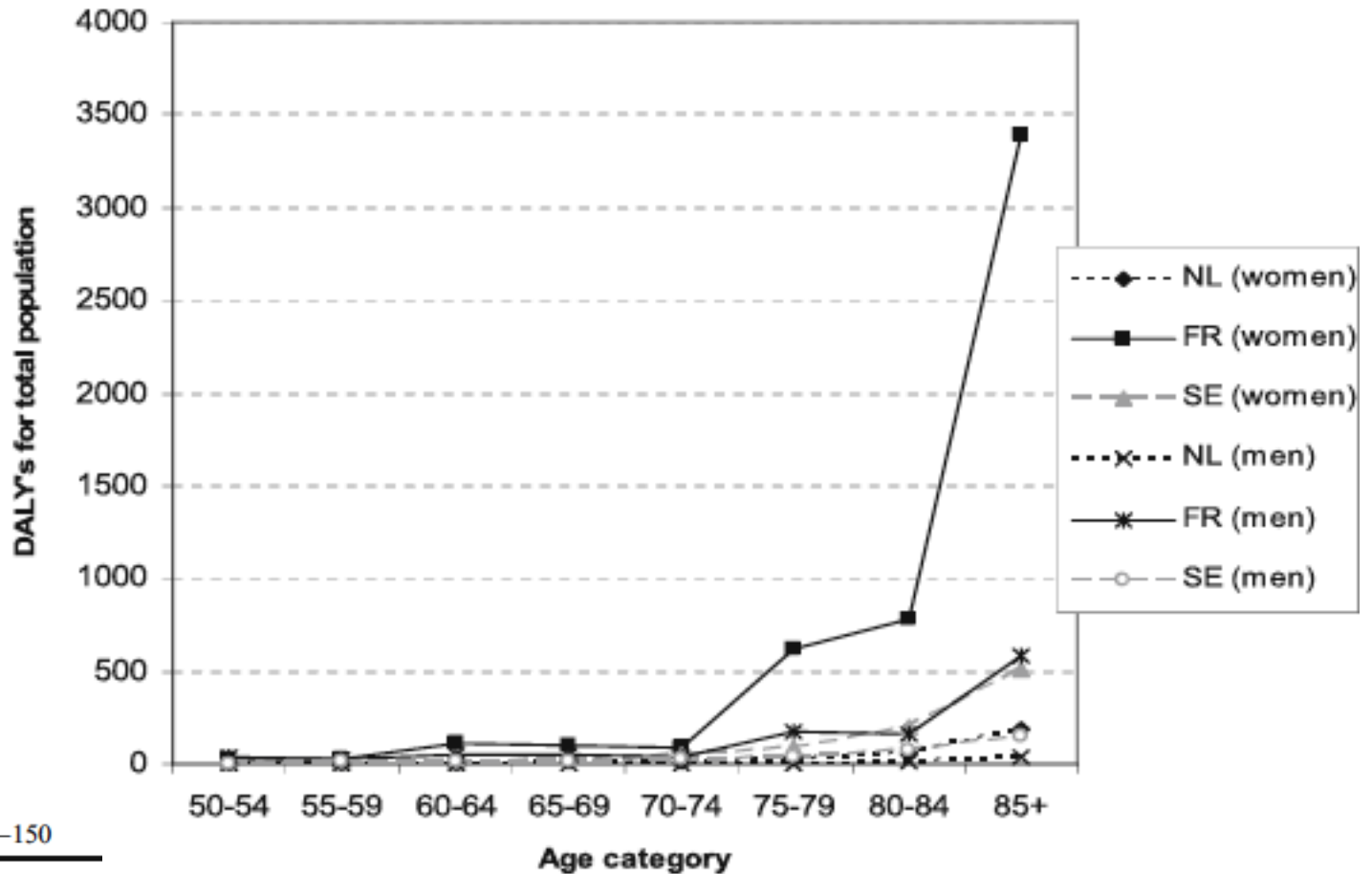
**Fig. 2 Potential impact fraction (absolute numbers)**



# Cost avoided through improved dairy foods consumption



# The burden of hip fractures in relation to ↓Ca Intake ( Disability Adjusted Life Years Lost)



Osteoporos Int (2013) 24:139–150

Fig. 3 DALYs lost, representing the burden of hip fractures in relation to low calcium intake



## Results of Model when applied to 3 countries

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- Potential Prevented Hip Fractures per year:

France:	2,023
Sweden	455
Netherlands	132.
- DALYs not lost per year:

France	6,263
Sweden	1246
Netherlands	374.
- Total costs potentially avoided  
129 million, 34 million, and 6 million Euros, respectively.
- Net benefits on future health and utilization of healthcare

# Hip fracture incidence/100,000 men and women > 50 years in EU 27

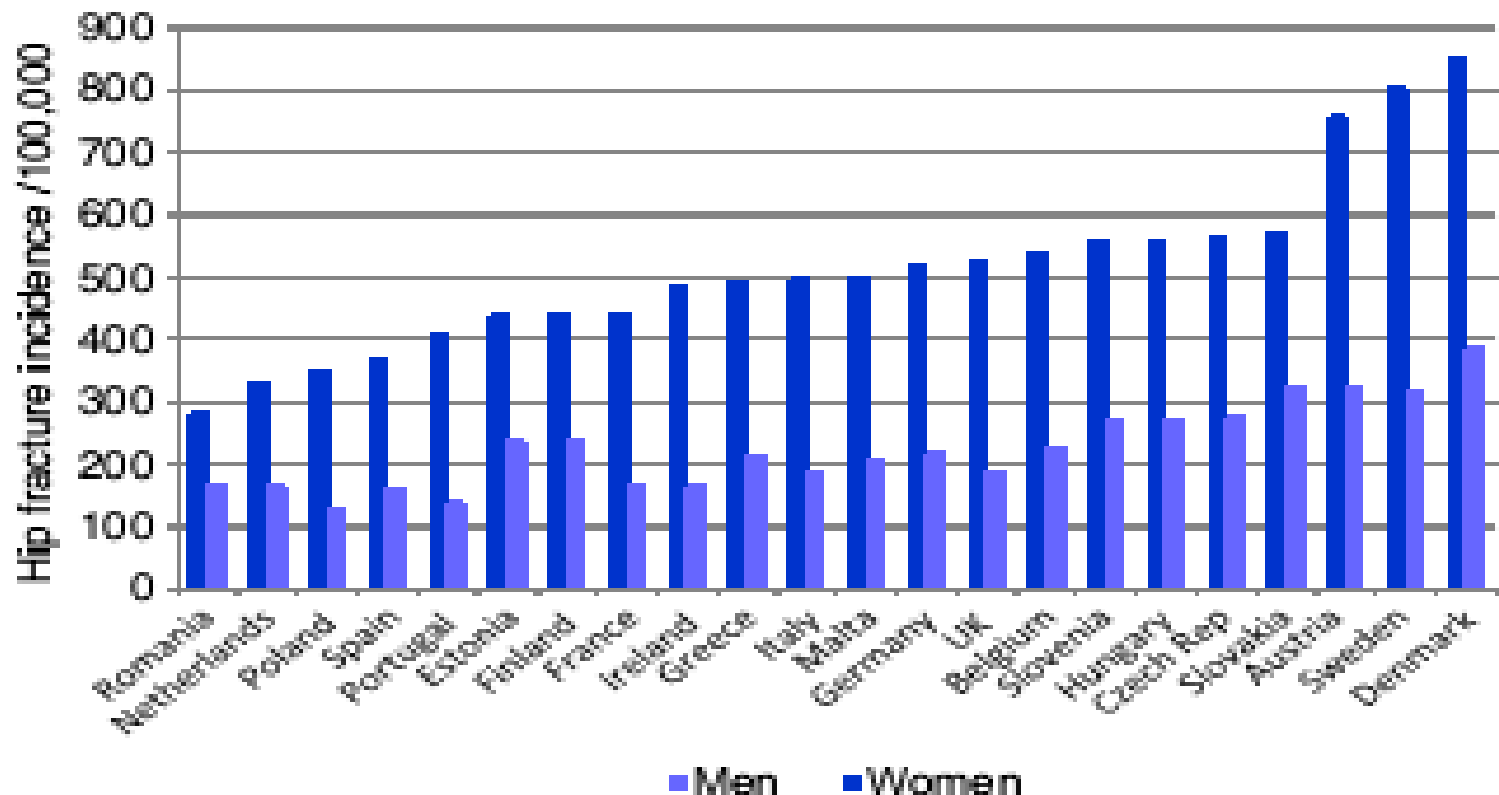
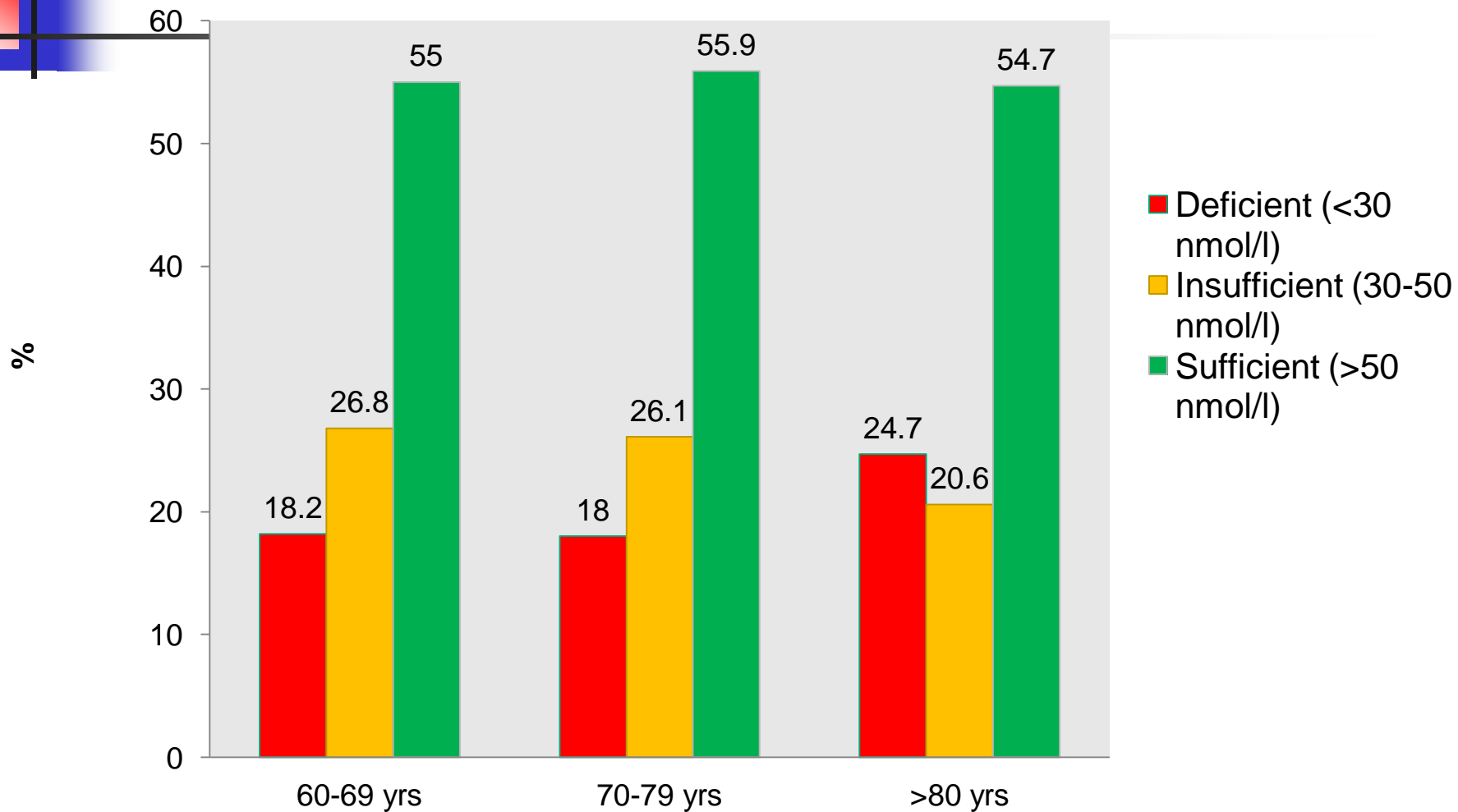


Fig. 24 Hip fracture incidence/100,000 in men and women above 50 years standardized to the EU27 population

## Baseline Characteristics of Bone Cohort (n = 3501)

	All (n 3501)	Hip fracture (n 138)	No Hip fracture (n 3356)	P value
% Male (n)	32.6 (1142)	23.2 (32)	33.0 (1107)	<0.001
Weight (kg)	74.0 (62.2,85.0)	62.0* (54.5,77.0)	74.0 (63.0,86.0)	<0.001
BMI (kg/m <sup>2</sup> )	27.8 (24.7,31.20)	25.4* (22.1,29.3)	27.9 (24.8,31.2)	<0.001
<b>Biochemistry</b>				
Serum Calcium	2.33 (2.24,2.42)	2.33 (2.25,2.41)	2.33 (2.2,2.42)	0.761
Phosphate	1.03 (0.89,1.16)	0.97* (0.84,1.10)	1.03 (0.90,1.16)	0.001
Albumin	42.0 (40.0,45.0)	41.0* (38.7,44.0)	42.0 (40.0,45.0)	<0.001
eGFR (mL/min)	71.7 (57.8,87.2)	56.2* (41.4,69.5)	72.2 (58.5,87.6)	<0.001
25(OH)D (nmol/l)	56.5 (36.8,81.4)	70.9* (41.5,69.5)	56.1 (36.8,80.9)	<0.001
PTH (pg/ml)	37.2 (27.5,49.3)	36.3 (28.4,56.1)	37.2 (27.5,49.2)	0.477

# Vitamin D status in TUDA Bone Cohort n= 3501



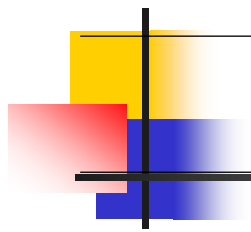
\*Institute of Medicine bone health cut-offs (2010)

# Bone Densitometry results median (inter-quartile range)

	All (n 3501)	Hip fracture (n 138)	No Hip fracture (n 3356)
Total hip BMD	0.903 (0.797,1.022)	0.722 * (0.636,0.822)	0.908 (0.80,1.027)
Total hip T-score	-1.0 (-1.8,-0.1)	-2.5 * (-3.0,-1.6)	-1.0 (-1.7,-0.1)
Femoral neck BMD	0.832 (0.748,0.926)	0.710 (0.644,0.774)	0.837 (0.754,0.933)
Femoral neck T-score	-1.4 (-2.1,-0.7)	-2.4* (-2.8,-1.8)	-1.4 (-2.0,-0.7)
Vertebral BMD	1.004 (0.874,1.170)	0.932* (0.795,1.121)	1.007 (0.877,1.173)
Vertebral T-score	-1.5 (-2.6,-0.2)	-2.1 * (-3.2,-0.6)	-1.5 (-2.5,-0.2)

\* p<0.001

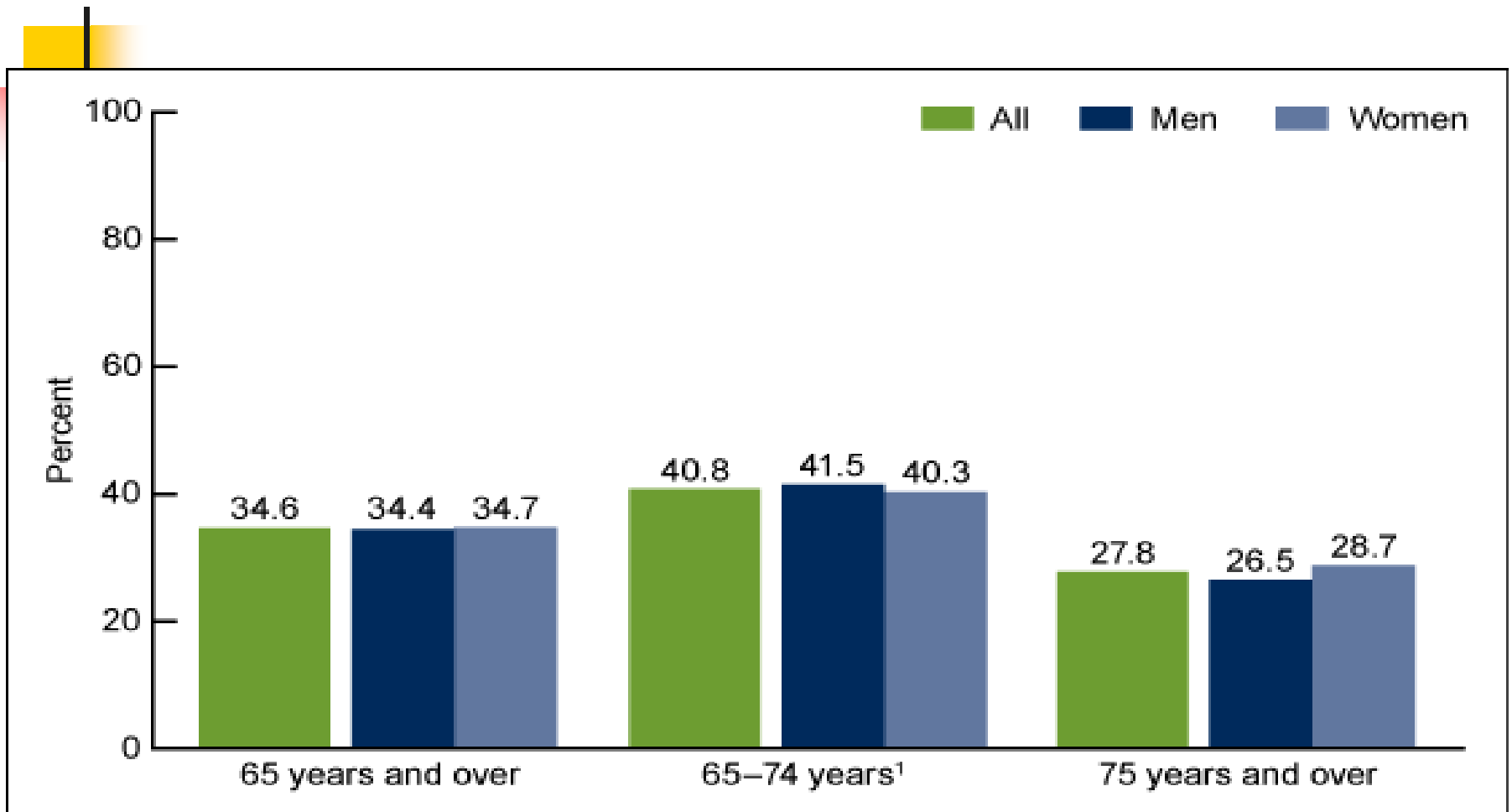
# TUDA Bone Cohort: Smoking and hip Fracture Risk



	All Bone cohort ( <i>n</i> = 3501)	Hip fracture ( <i>n</i> = 138)	No hip fracture ( <i>n</i> = 3356)	P-value
Smoking; Never % (n)	47.1 (1649)	44.9 (62)	47.2 (1583)	<0.001
Current % (n)	12.3 (432)	22.5 (31)	11.9 (400)	<0.001



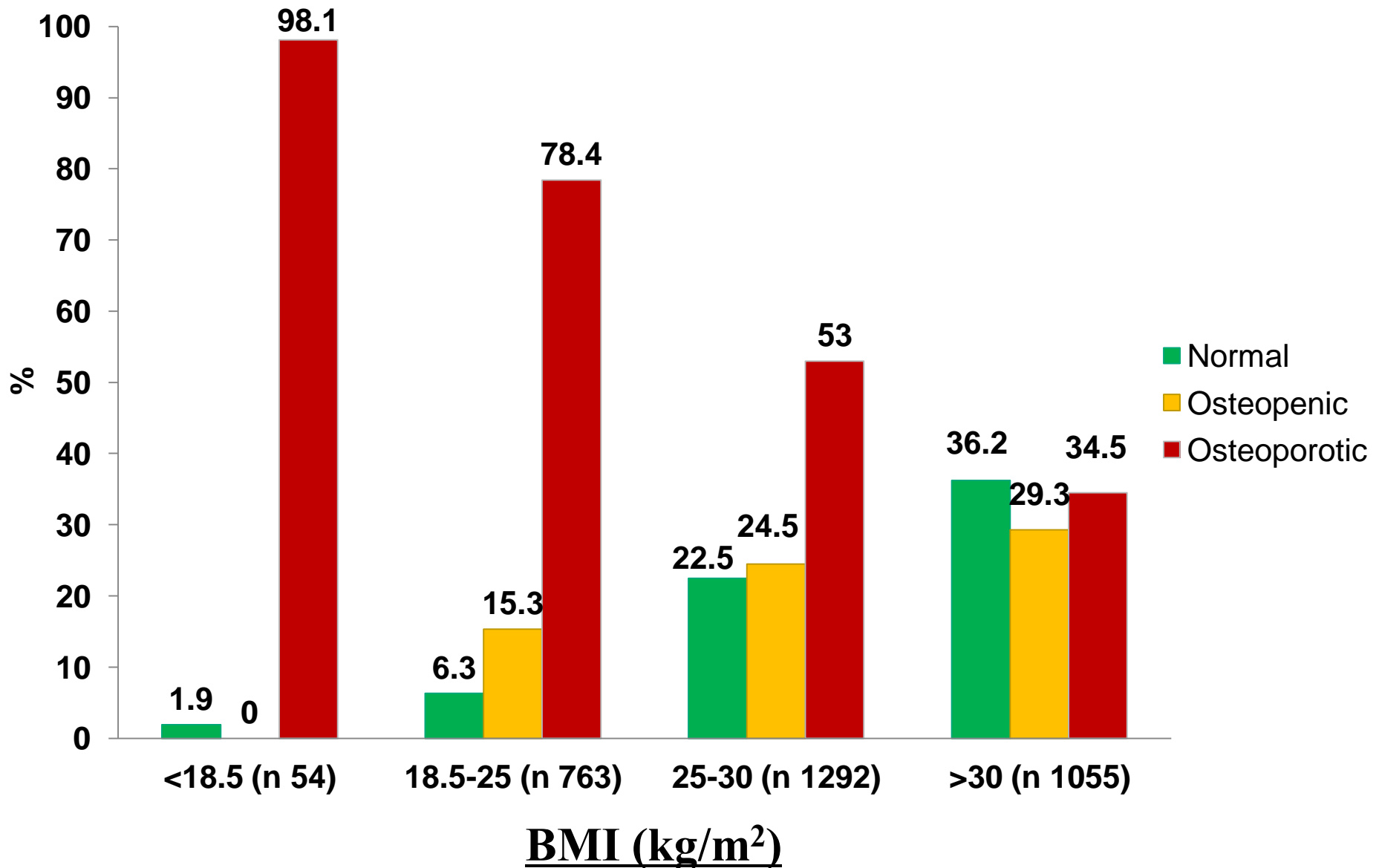
## Prevalence of obesity among adults aged 65 and over, by sex: United States, 2007–2010



<sup>1</sup>Significantly different from 75 years and over.

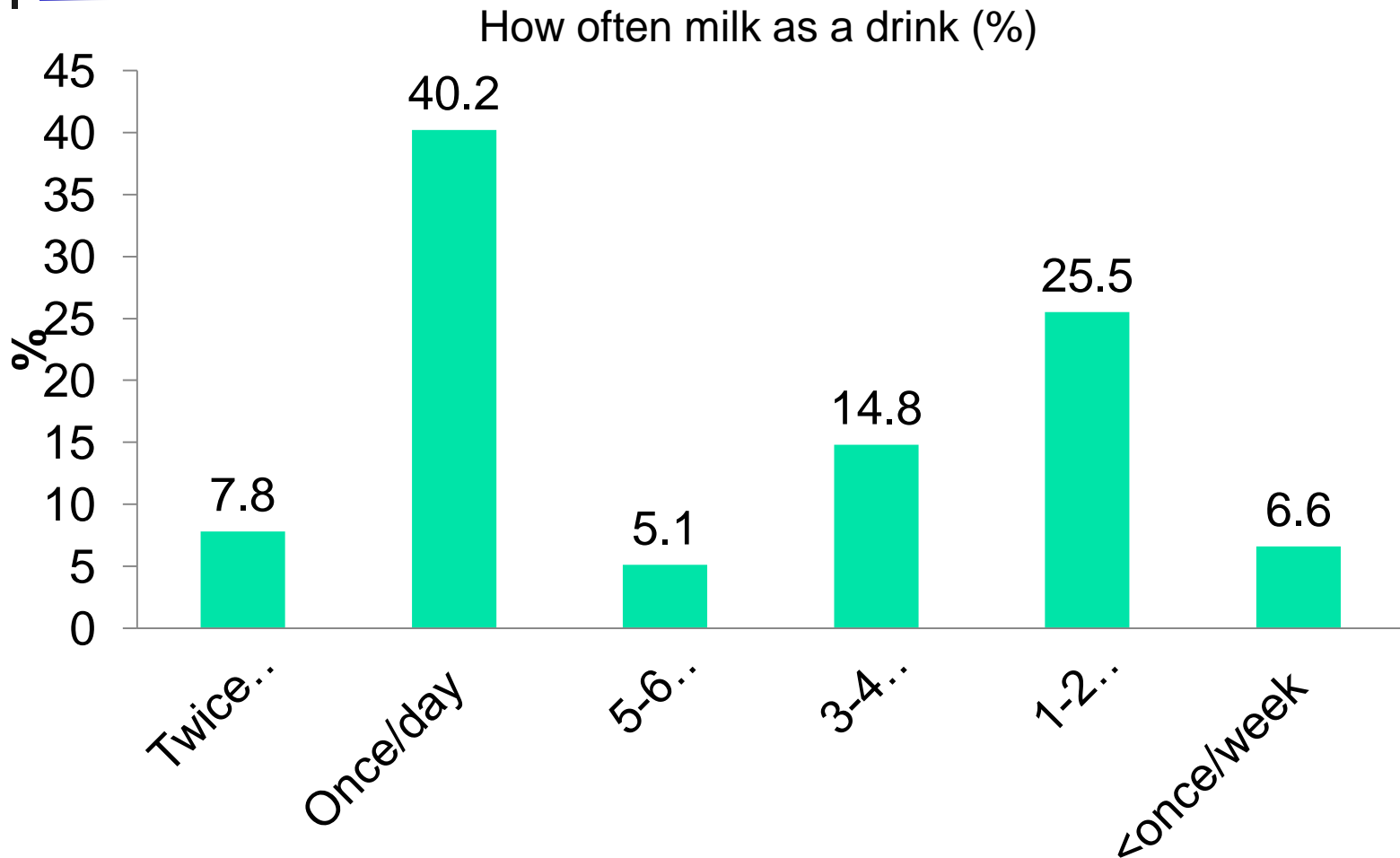
SOURCE: National Health and Nutrition Examination Survey, 2007–2010.

# BMI and prevalence of Osteoporosis



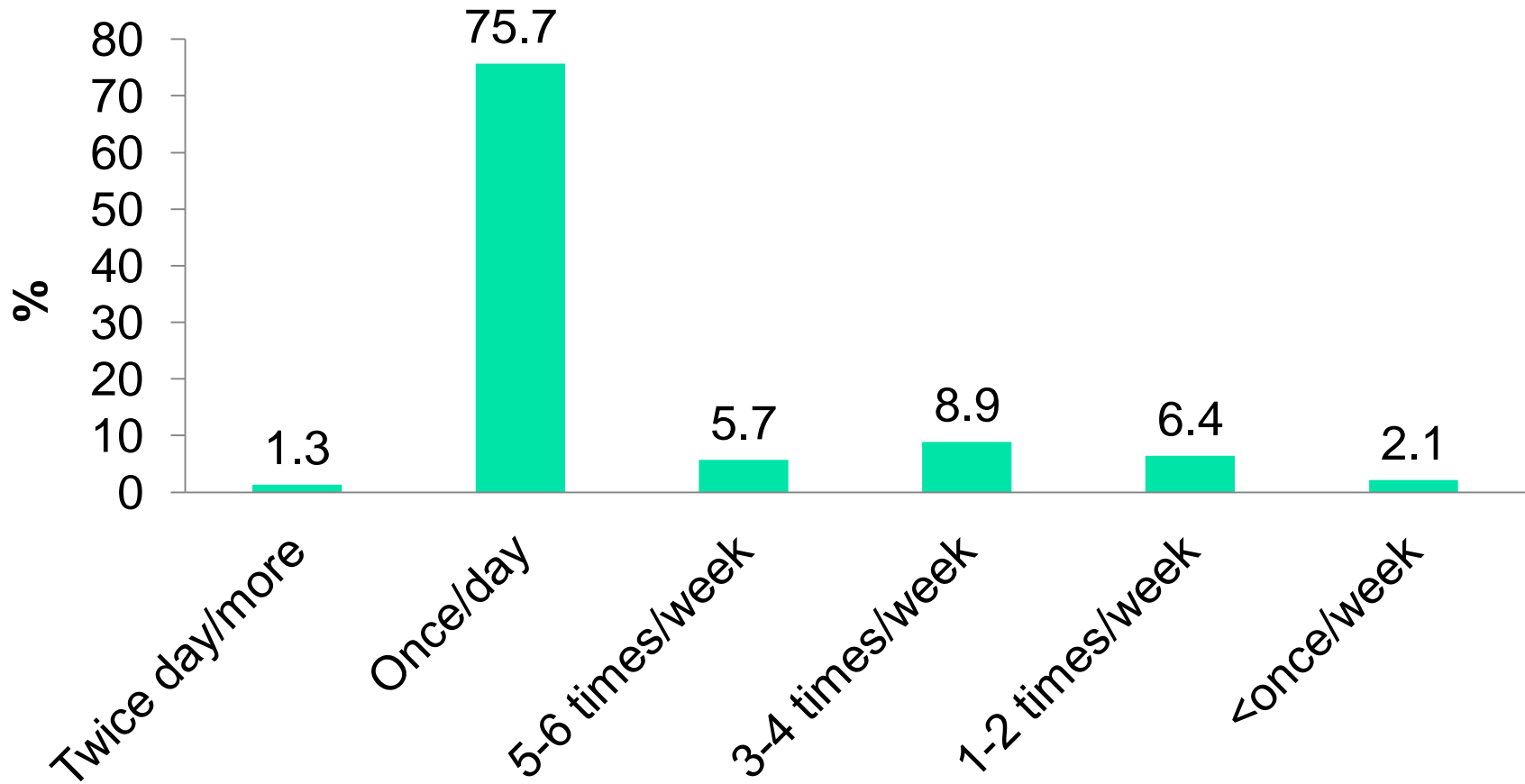
Milk Consumer: 98.6%

42% (n = 1445) said they had **Milk as a drink**

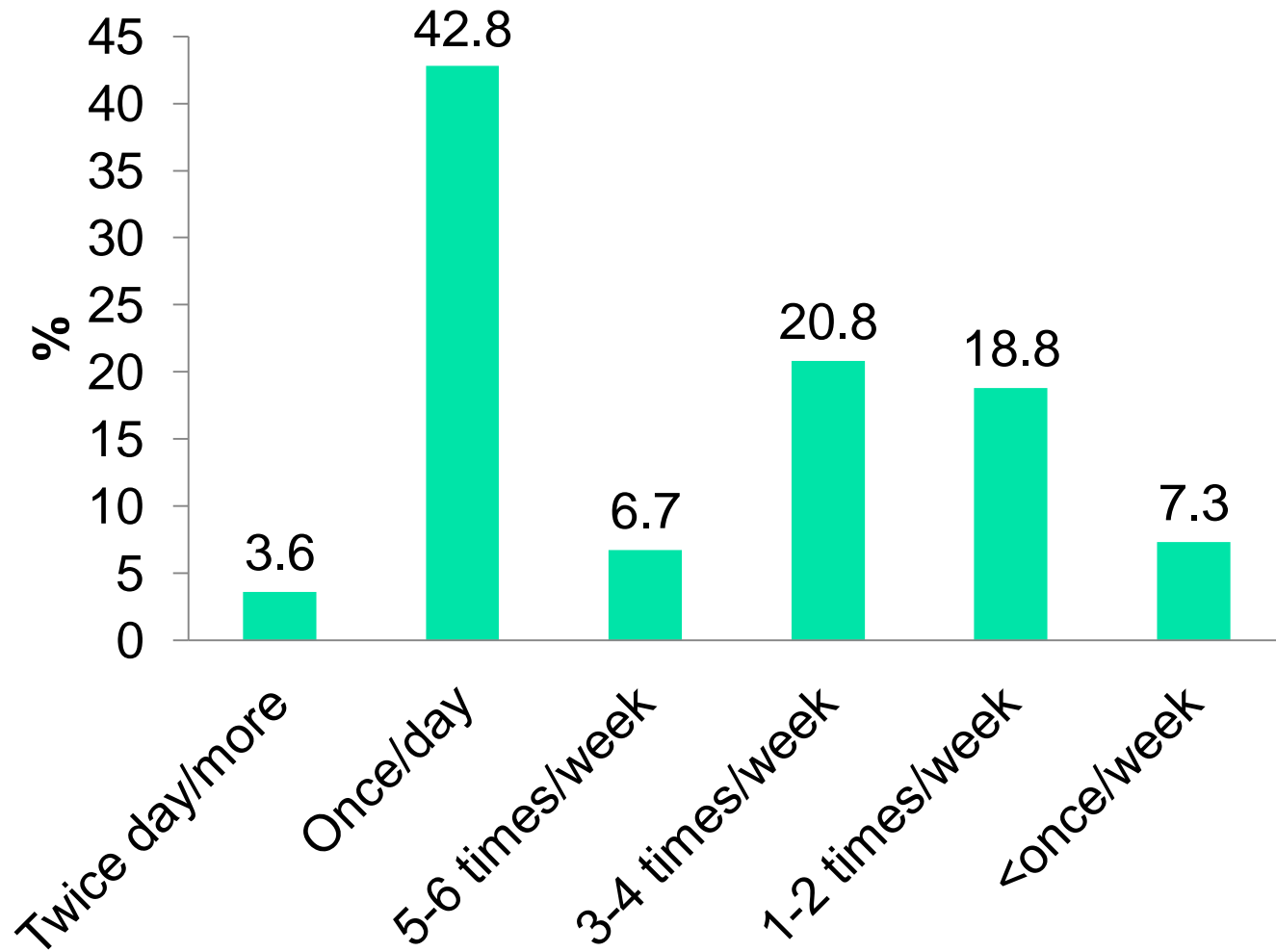


80.5% (n = 2767) said they had Milk with a Cereal

How often milk with cereal (%)



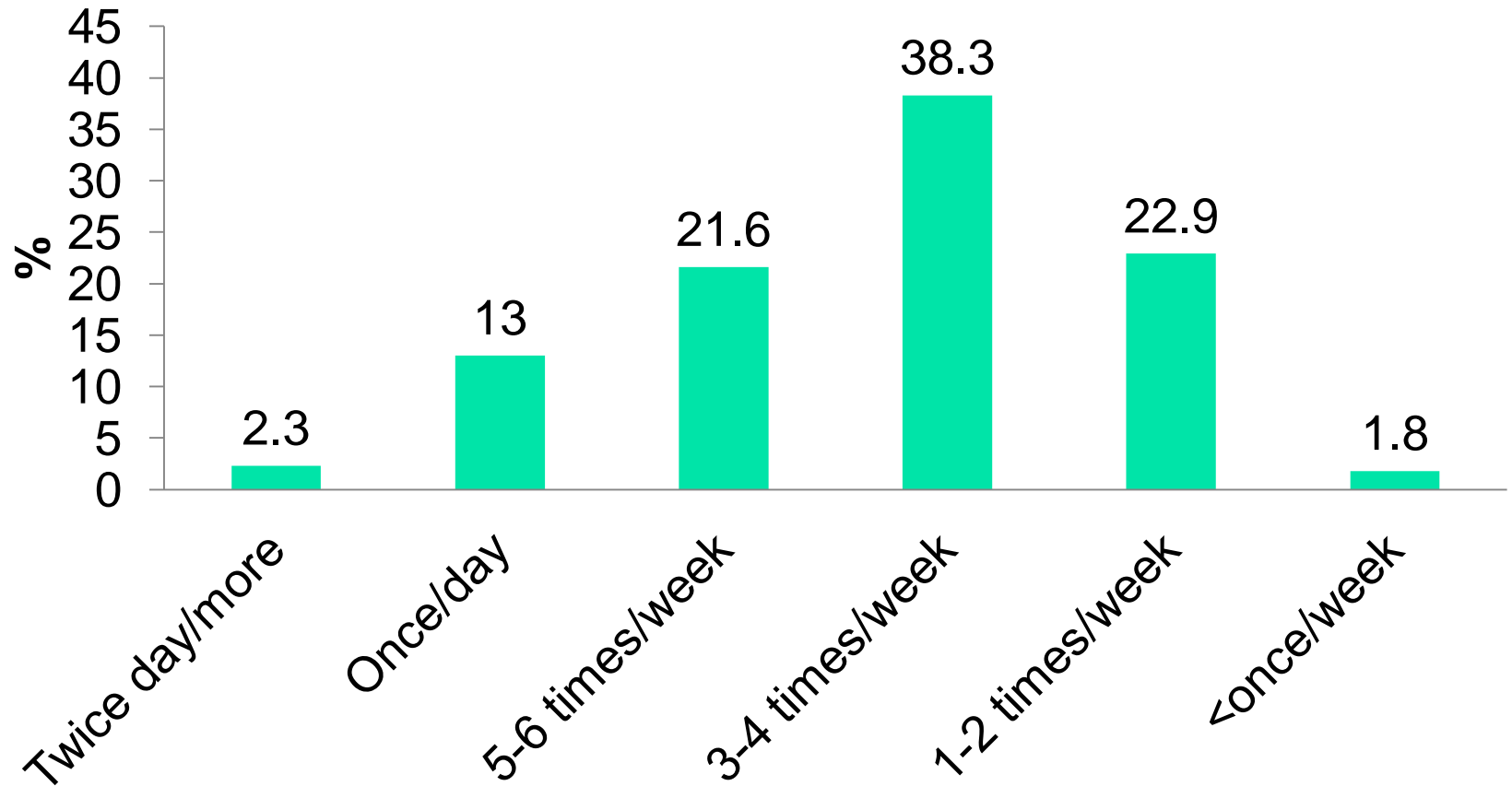
63.7% (n = 2227) said they consumed Yoghurt



# Meat

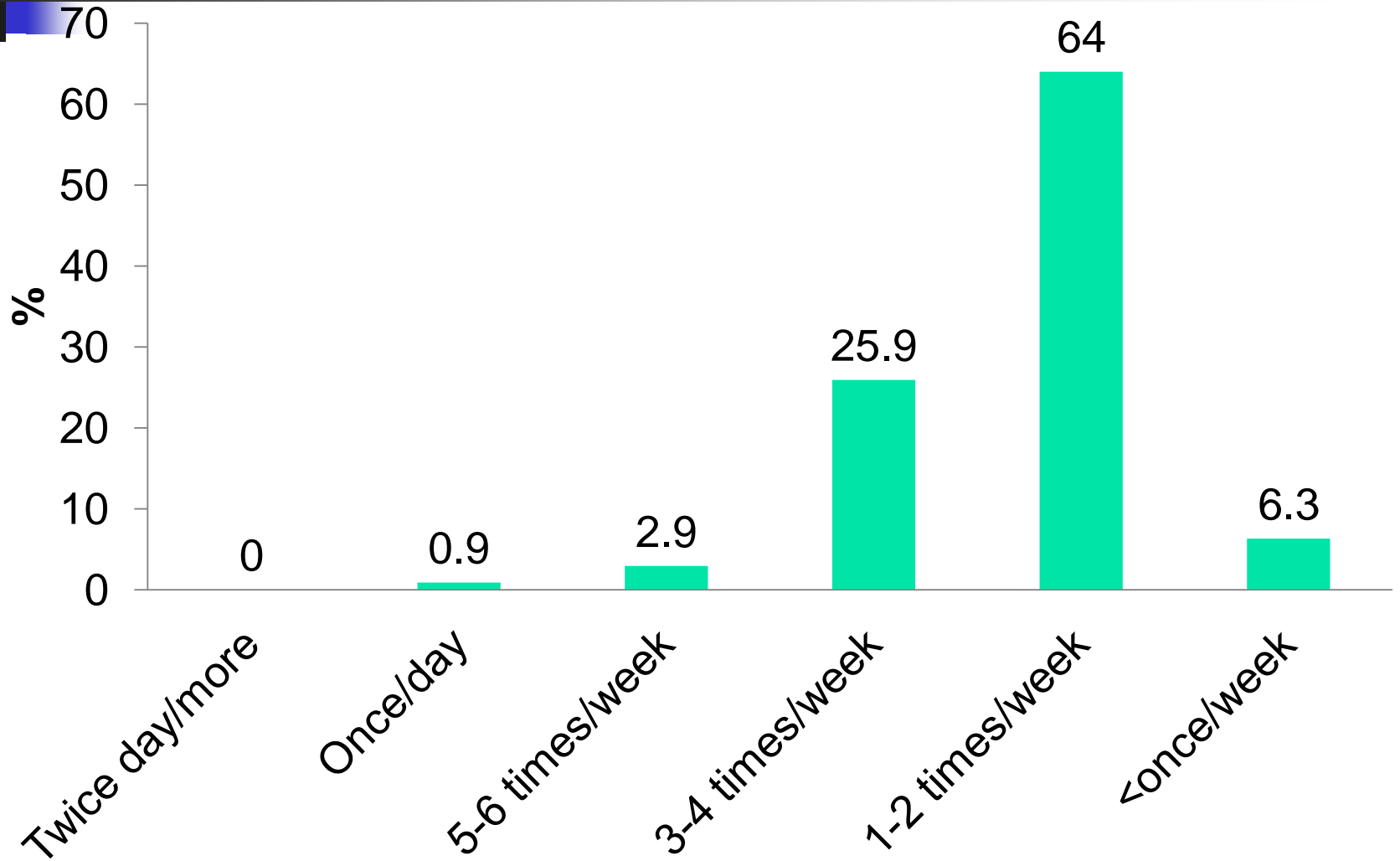
96.8% (n = 3389) consumed it

How often consumes meat



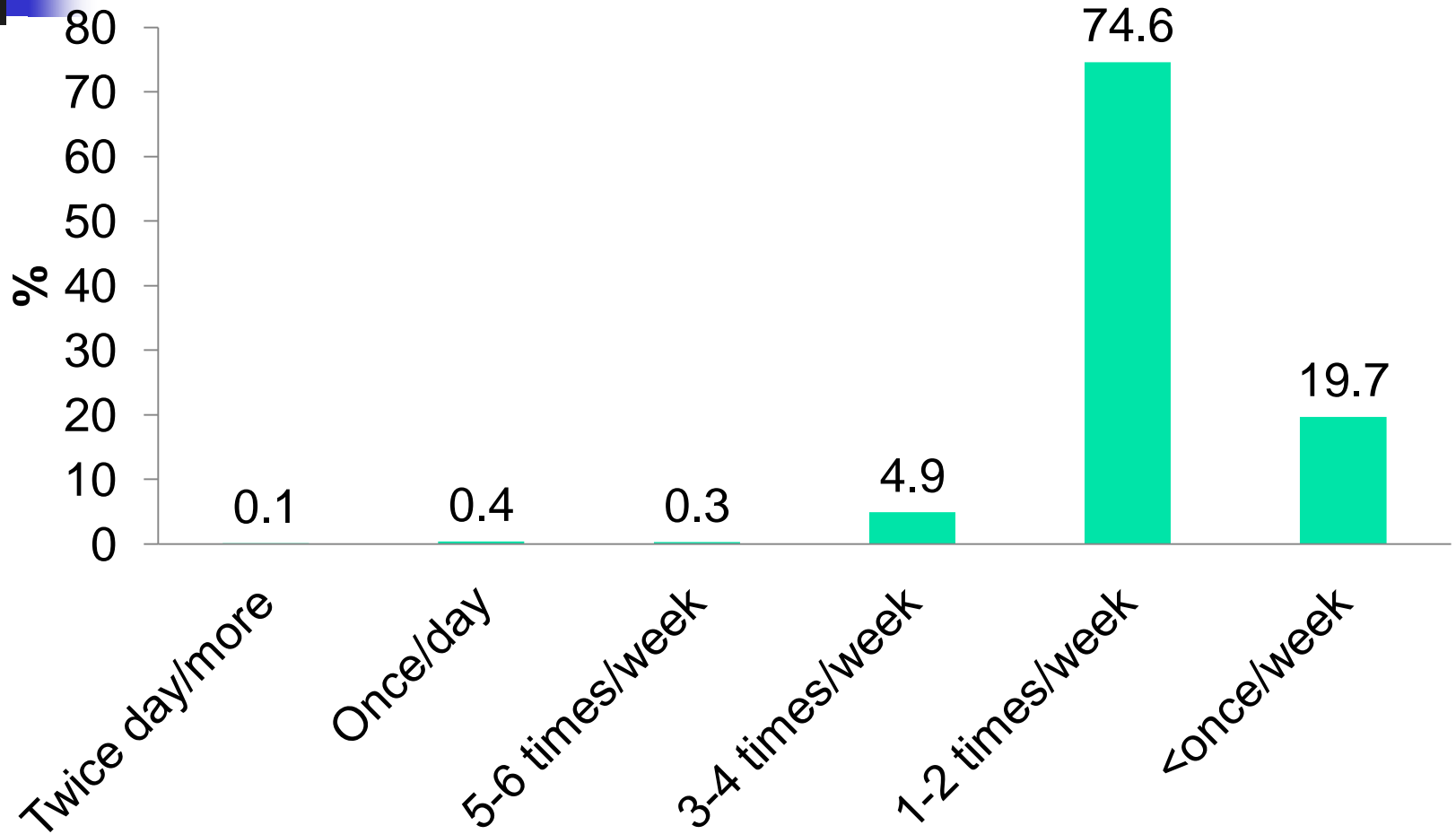
# Poultry

96.2% ( n = 3249) said they consumed it



## White Fish

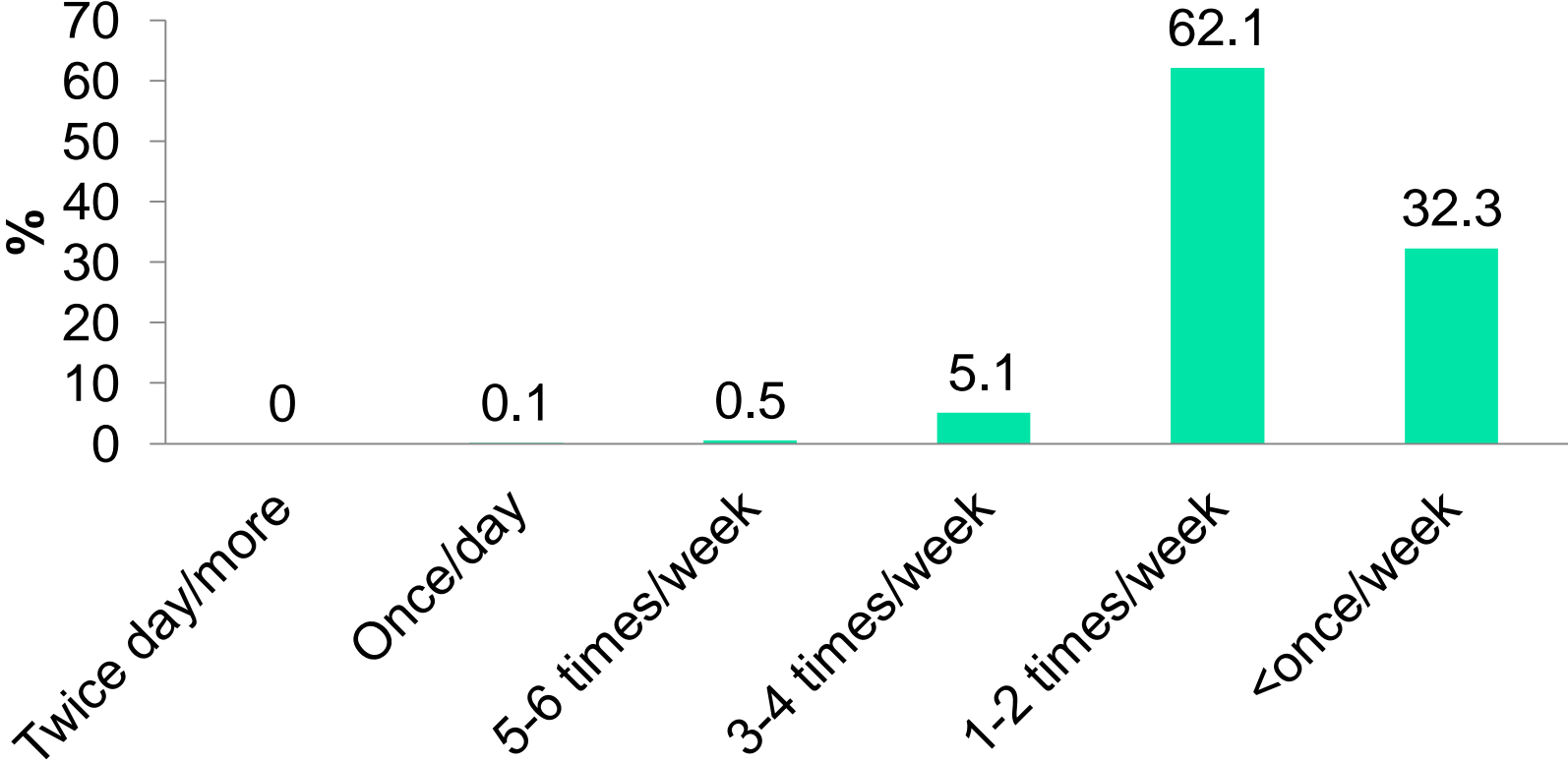
81.7% ( n = 2857) said they consumed it

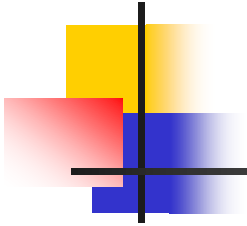




# Oily Fish

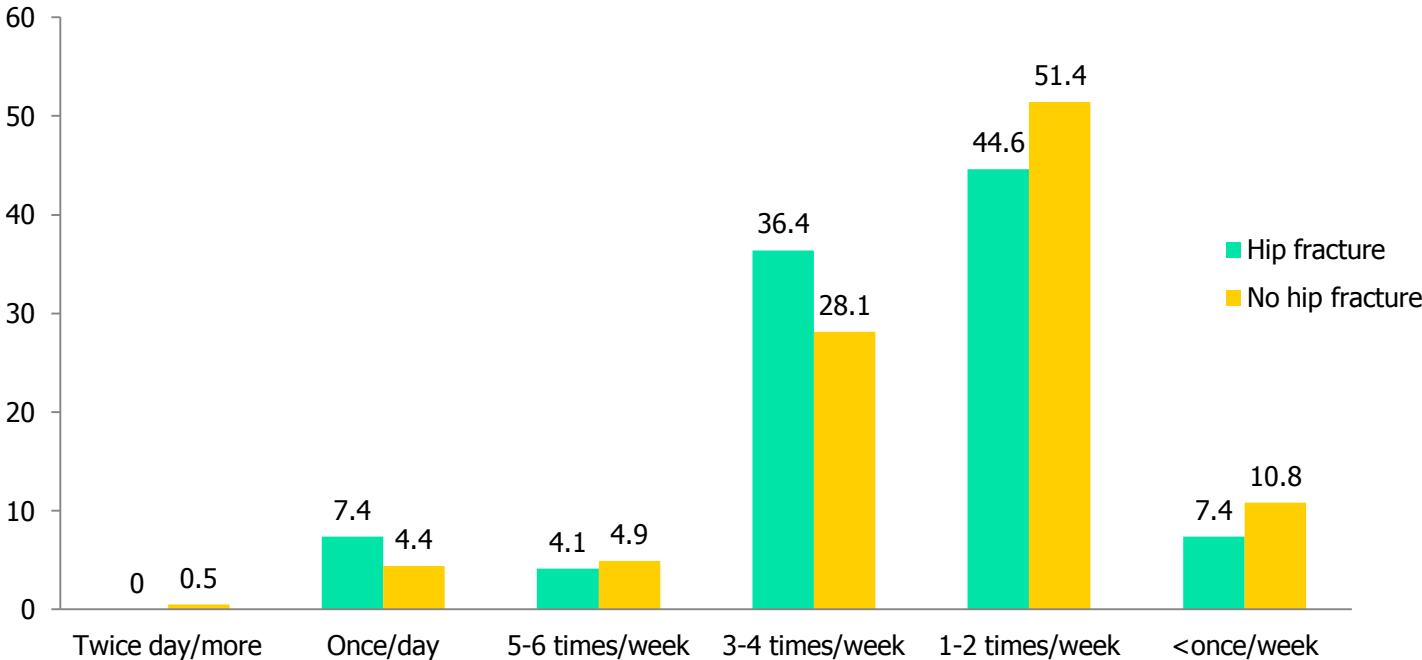
63.2% (n=2209) said they consumed it





# Eggs

87% said they consumed them





# Summary:

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Overall consumption of Dairy products and Animal Protein as per food pyramid in Elderly osteopaenic patients sub optimal.

**Public Health** policies for Ireland

**Worldwide: \$14 billion** in savings on the healthcare costs for osteoporosis (*limited to treating fractures*) if recommended quantities of dairy produce taken



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THE DEPARTMENT OF  
**AGRICULTURE, FISHERIES & FOOD**  
AN ROINN TALMHAÍOCHTA, IASCAIGH AGUS BIA

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- Eamon Laird
- Conal Cunningham
- Kevin McCarroll
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- Gerry Cox
- Sinead McNiffe
- Helen Toohey
- Regina Dempsey
- Karen Creevey
- Tracey Claxton

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

## At UU

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- Sean Strain
- Mary Ward
- Leane Hoey
- Geraldine Horigan
- Julie Wallace
- Shauna Harte
- Paula Tighe
- Mary McCann
- Liadhan McAnena
- Julie Sittlington
- Kim Martin
- Ingrid Love
- Catherine Hughes
- Adrian McCann

**"WE ONLY INVENTED COOKING YESTERDAY,  
AND ALREADY SHE'S SERVING LEFTOVERS!"**



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