Fortified Milk in Practice

Joanne Corbett, BSc, DBS, MSc, MINDI

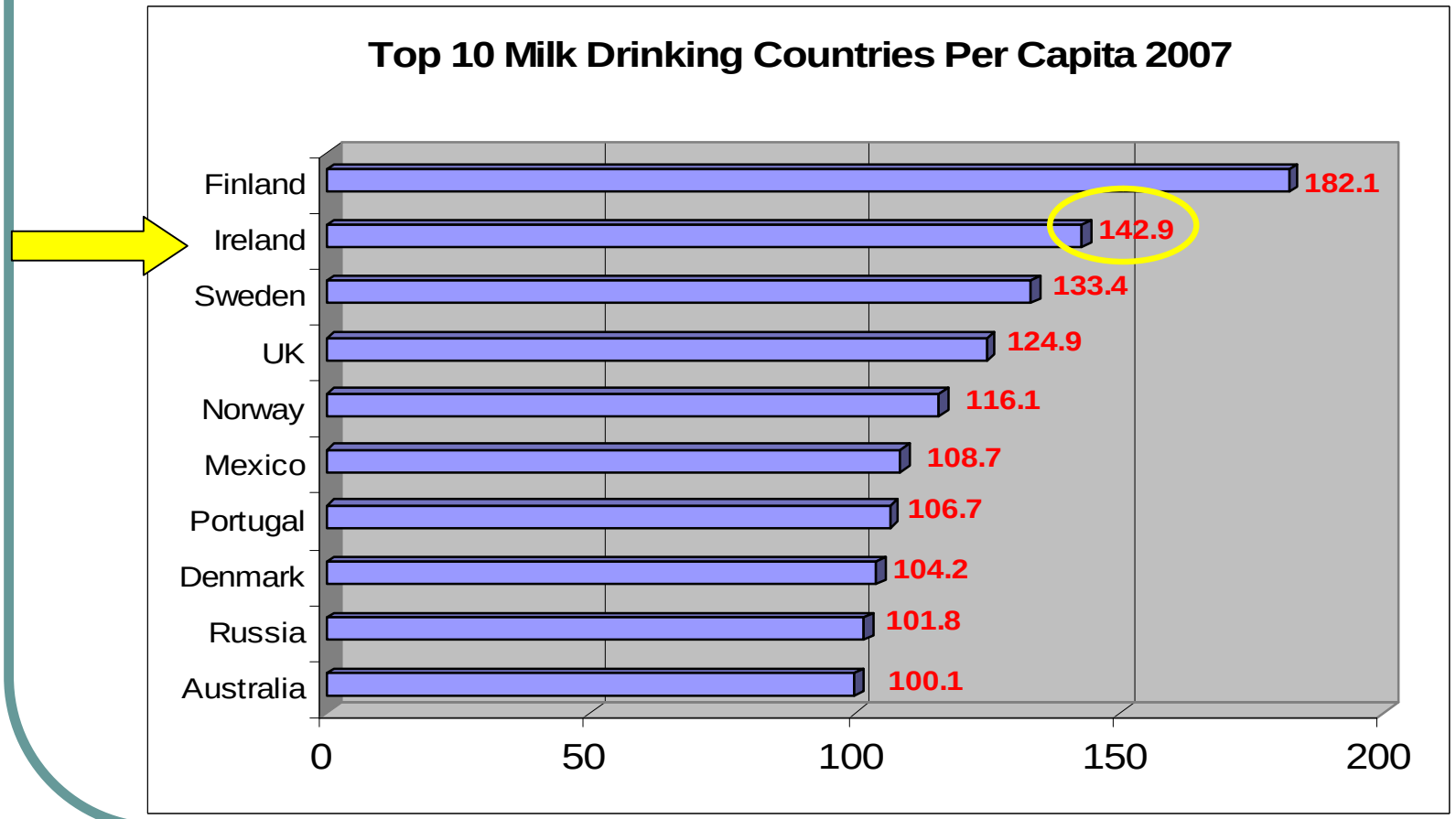
Consultant Dietitian

www.nutritionwise.ie

Milk and fortified milk in Ireland

Milk Consumption Levels Per Capita

Ireland still has one of the highest per capita consumption levels of milk in the world



Ireland is the home of great milk!
When it comes to producing Milk, Ireland is unique…

Only New Zealand and Australia are similar!

Irish cows spend more time outside than any other cows
…and cows eating grass produce tastier, creamier milk!

Categories of Milk

100mls	Whole milk	Low fat	Skimmed	Fortified
Energy (kcals)	66	46	32	49
Protein (g)	3.5	3.5	3.4	3.4
Fat (g)	3.5	1.5	0.2	1.5

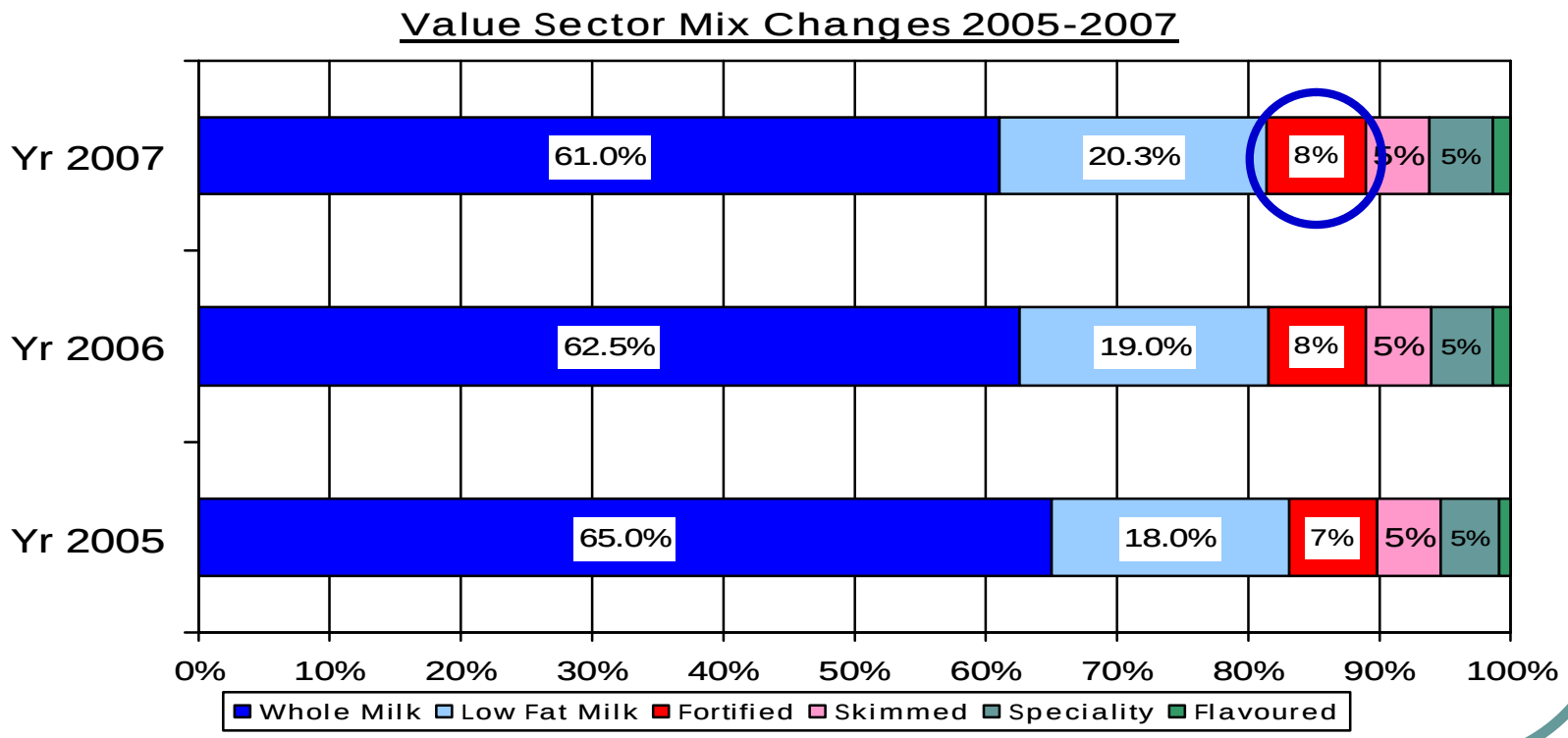
- Cows milk unsuitable as main drink <12m
- Children from 2 years with varied diet with adequate energy can use low fat milk
- Children from 5 years old can consume skimmed milk

Fortified versus Whole Milk

Average values per 200ml serving	Fortified Milk	Standard Whole Milk
Energy (kcal)	98	128
Protein (g)	6.8	6.6
Carbohydrate (g)	10.4	9.8
Fat (g)	3.0	7.0
Vitamin B12 (µg)	0.8	0.8
Calcium (mg)	**332**	236
Vitamin A (µg)	**240**	104
Vitamin B2 (mg)	**0.48**	0.32
Folic Acid (µg)	**140**	12
Vitamin D (µg)	**2.0**	0.06
Vitamin E (mg)	**3.0**	0.18

The Fortified Milk Sector

Fortified milk sector growing at an accelerated rate over the past 6 months, current growth is at 24% *(in value terms, MAT Feb 08).*



Source: Extended Scantrack MAT June 05-07

Milk and Dairy

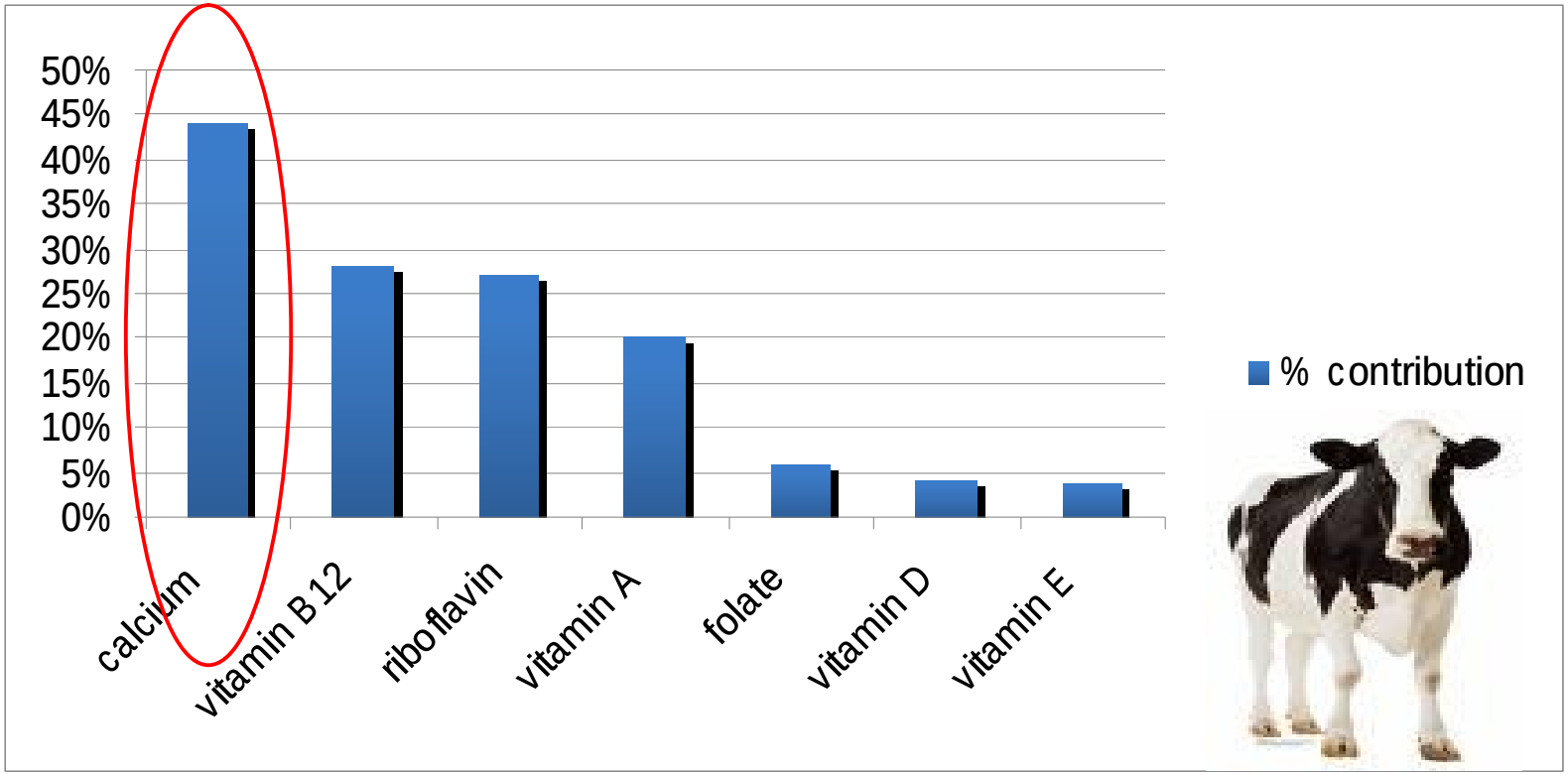
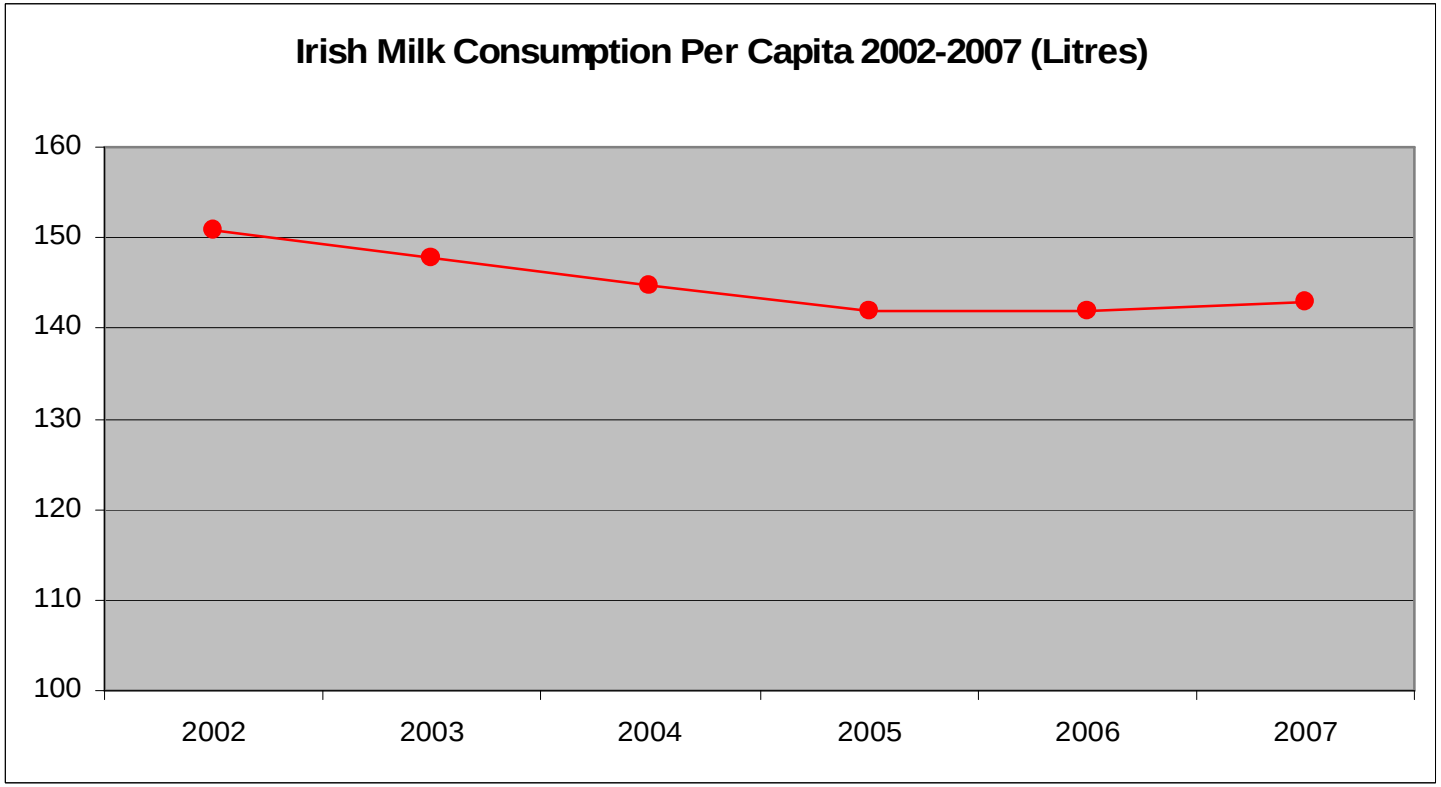


Figure. % contribution of milk, yoghurt and cheese to nutrient intakes in adults

IUNA, 2001

Per Capita Milk Consumption in Ireland Decreasing

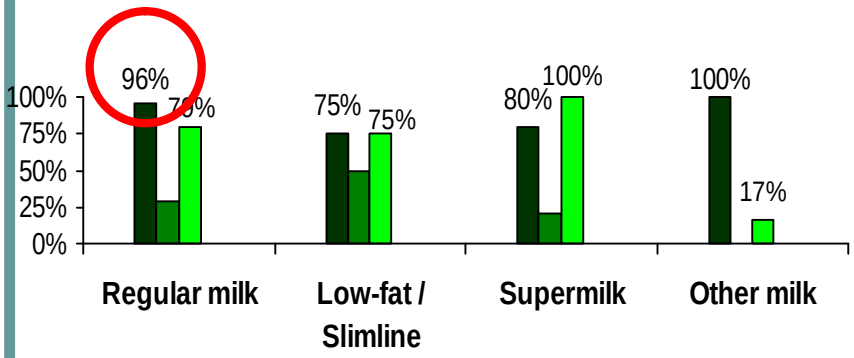
Consumption is decreasing (151 litres per capita in 2002 to 143 litres in 2007) (Source: Datamonitor)



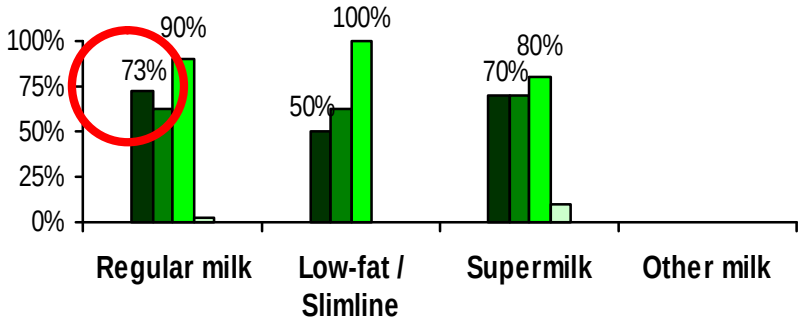
Consumption of milk as a ‘beverage’ decreases with age

- **As we grow up, we tend to move away from drinking milk as a beverage**

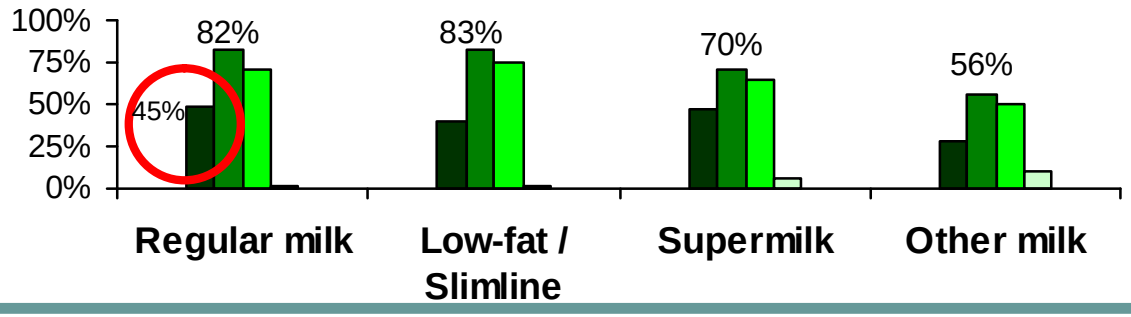
Pre-school

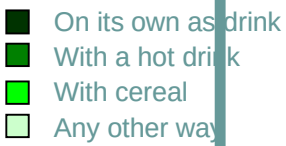


Secondary



ADULTS





Regular milk: Base 270 adults
Low-fat / Slimline: Base 153 adults
Supermilk: Base 53 adults
Other milk: Base 18 adults

BMR Research

Milk and Dairy - UNDERUTILISED

- Men: 2.5 servings daily
- Women: 1.5 servings daily

(IUNA/NDC, 2002)

Attitudinal data (IUNA, 2001)

Table. % subjects selecting the most appropriate response re. self-assessed adequacy with respect to consumption of various foods (IUNA, 2001)

Food/ drink	n	Eat/drink about the right amt	Eat/drink too much	Eat/drink too little	Don't eat/drink	Don't know
Milk	1251	61	9	22	4	4
Cheese	1253	46	16	21	14	3
yoghurt	1252	29	2	31	35	3

Attitudinal Data – Adults (IUNA, 2001)

"i don't need to make changes to my diet as it is healthy enough"

		n	Strongly agree	Tend to agree	Tend to disagree	strongly disagree	Don't know
Total sample		1254	11%	41%	30%	11%	7%
Sex	Male	583	13%	42%	28%	9%	8%
	Female	671	10%	40%	32%	12%	6%
Age	18-35yrs	491	5%	36%	37%	14%	8%
	36-50yrs	473	11%	44%	30%	10%	5%
	51-64yrs	290	23%	43%	20%	5%	8%

Public health issues in Ireland??

Dietary Habits

- **National Childrens Food Survey**
  - Mostly white bread
  - Mostly processed meat
  - Low fruit and veg intakes
  - Sugary drinks
- **Main source of energy:**
  - Bread & cereals
  - confectionary/snacks/biscuits
  - Milk & dairy
  - Potatoes (IUNA, 2005)

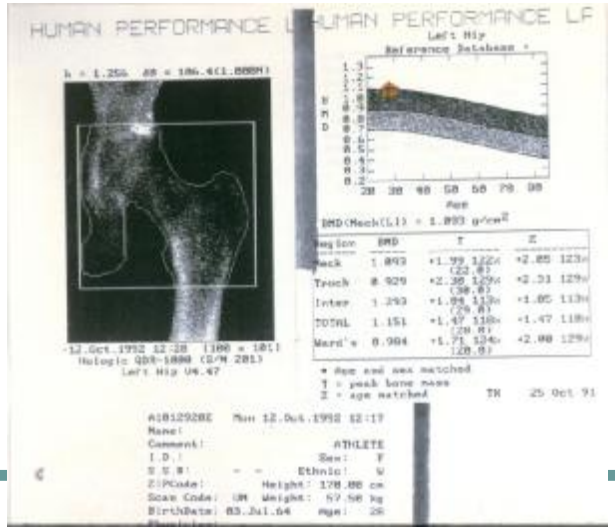
Public health issues in Ireland??

WIDESPREAD LOW VITAMIN D

NTDS

RICKETS

OSTEOPOROSIS



Food Fortification

- *Addition of one or more essential nutrients to a food whether or not it is normally contained in the food*

Codex Alimentarious Commission, 1987

Food Fortification

+	-
Improves micronutrient intake without significant changes in eating patterns which are notoriously difficult to achieve at population level	Not a substitute for balanced diet
Restoration of nutrients lost during food processing e.g. Adding iron & thiamin back to white and brown flour	Potential implications for other nutrients in the diet e.g. Folic acid and masking of B12 deficiency
Substitution e.g. Margarine with added vitamins A and D	Excessive intakes – public health risk
Stability e.g. Vitamin C added as an antioxidant (E300) in tinned veg	

Contribution of Fortified Foods to nutrient intakes in Irish Adults

- Fortified food consumers (IUNA, 2001)
- 2% of 3000 foods recorded were fortified
  - Cereals, fortified milk, other beverages, cereal bars
- Data collection 1997-1999
- Fortification significantly improve adequacy of intake of riboflavin, folate, vitamin D and iron in women
- Did not contribute to increased risk of adverse effects from excessive intake

Hannon et al., 2007

Contribution of Fortified Foods to nutrient intakes in Irish Children

Table. Mean daily intake < average requirement

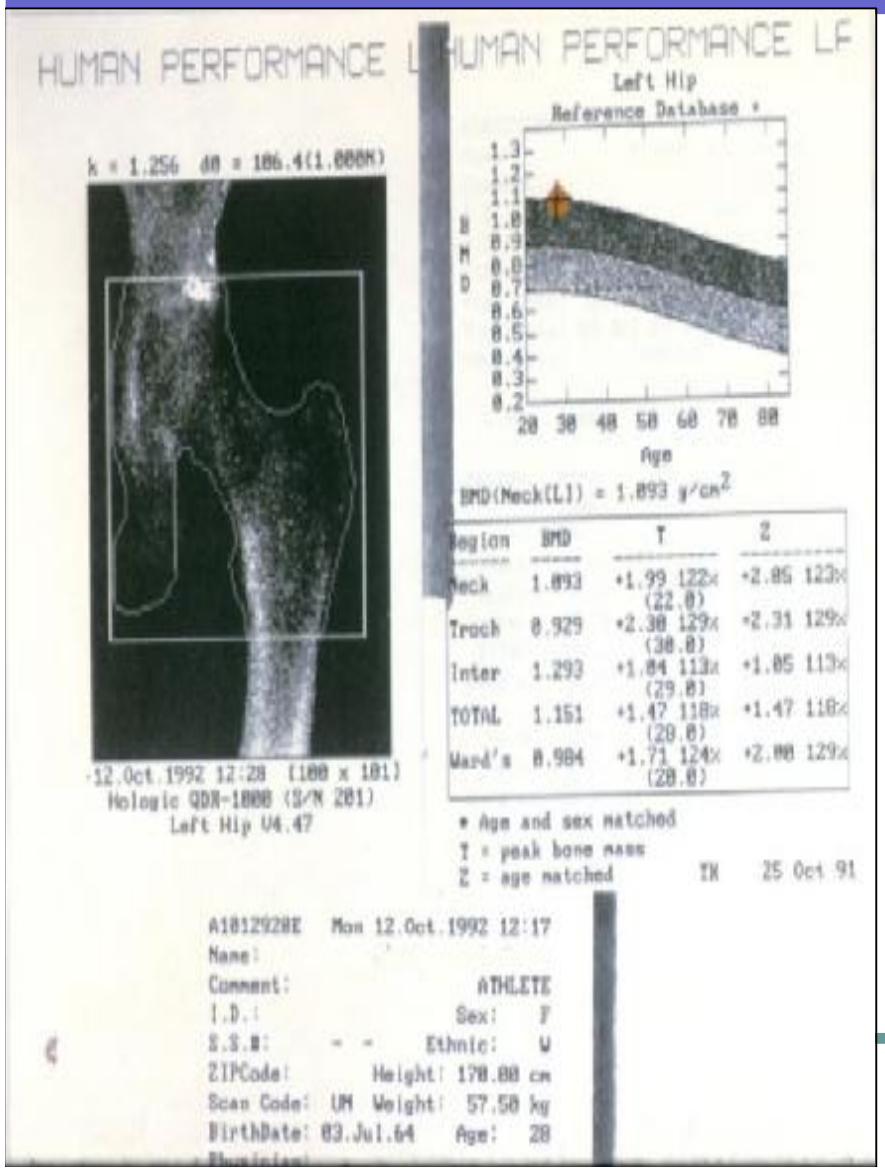
	Percentage with MDI<AR			
	Boys (*n* 290)		Girls (*n* 293)	
	Added nutrients not included	Added nutrients included	Added nutrients not included	Added nutrients included
Vitamin A	23	22	26	24
Riboflavin	21	8	23	13
Vitamin B_6	13	3	17	3
Folate	57	20	67	35
Vitamin C	13	10	13	10
Ca	32	28	42	35
Fe	75	28	85	51

Hannon and Flynn, 2006

The role of **fortified milk** in the context of public health nutrition issues in health and disease

- Osteoporosis
- Widespread inadequate vitamin D
- Re-emergence of rickets in infants
- Neural Tube Defects

Osteoporosis

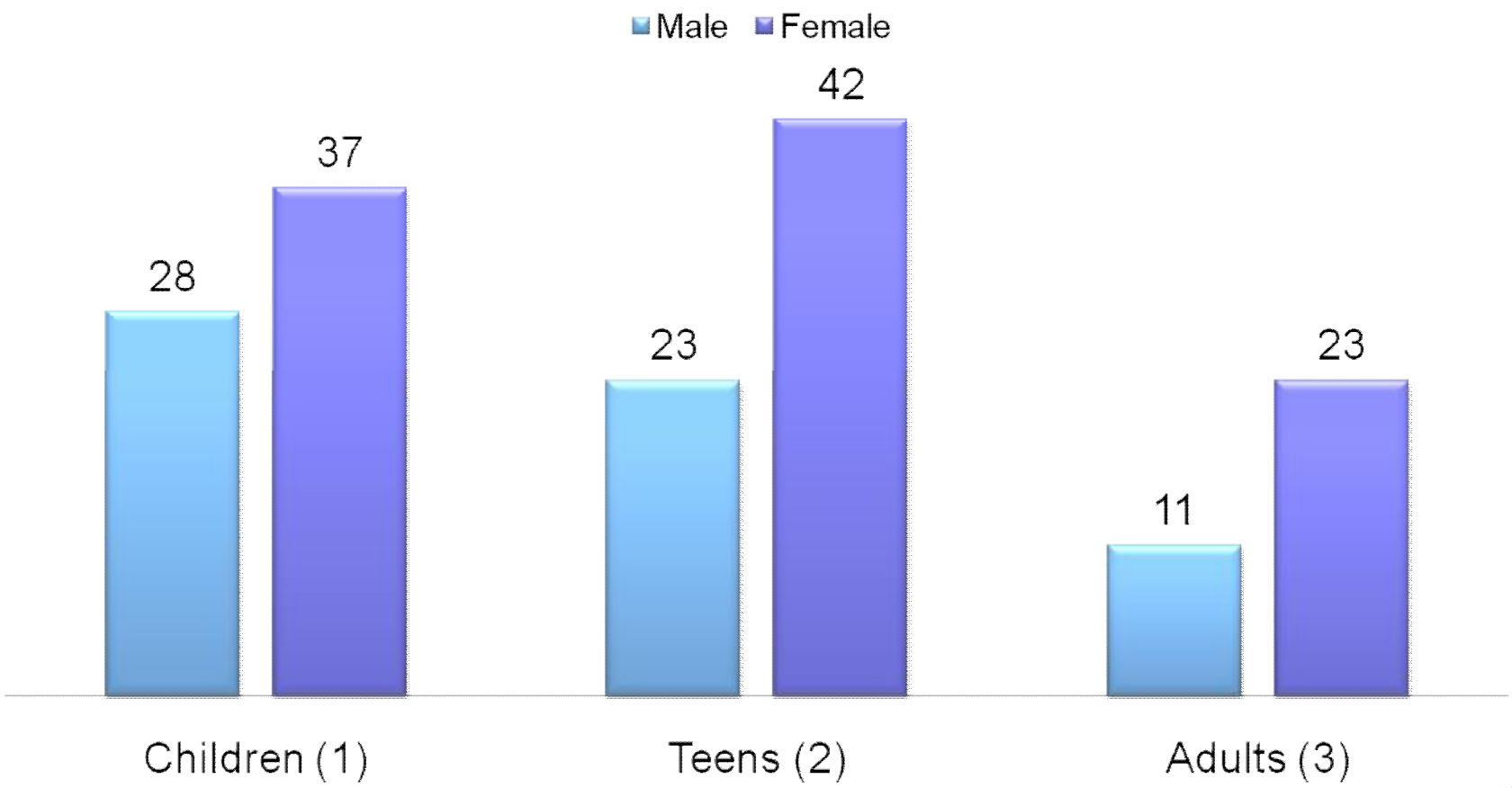


- **Commonest disorder of bone**
- **Fracture >50 yrs** { **1:3 women** / **1:5 men**
- **Major challenge to healthcare**
- **Largely preventable**

Osteoporosis Risk Factors – ‘healthy’ population

Unmodifiable	Modifiable
Genes	Lack of dietary Calcium or Vitamin D
Female	Lack of / excessive exercise
Aging	Excess alcohol intake
Early menopause/hysterectomy	Cigarette smoking
Reduced sun exposure	Restricted dieting

Prevalence of calcium inadequacy in Ireland



(1) IUNA, 2005 (2) IUNA, 2008 (3) Hannon et al., 2001

Vitamin D deficiency

- High risk populations
  - Elderly/institutionalised
  - Hospital in-patient population
  - Infants
  - Ethnic minorities
  - pregnancy

Widespread vitamin D inadequacy/deficiency

- Mean daily intakes (IUNA
  - 2.3µg children
  - 2.7µg teens
  - 3.7µg adults

- Widespread vitamin D inadequacy in healthy population (Keane et al., 1995; Hill et al. 2005, 2006, 2008; Andersen et al. 2005; McCarthy et al. 2006; O'Sullivan et al. 2008)
- Re-emergence of rickets in infants & toddlers

Patients at ↑ risk of osteoporosis

- Coeliac disease
- IBD
- Low BMI (<19kg/m^2)
- Female athlete
- Downs Syndrome
- Restrictive Diets
- Eating disorders
- Chronic Renal Failure
- Chronic Liver Disease
- Hyperthyroidism
- Prolonged immobilisation
- Premature menopause
- Prolonged 2° amenorrhoea
- Cushings syndrome
- Corticosteroid therapy
  - PO prednisolone ≥3m
- Anticonvulsant therapy

Adapted from Royal College of Physicians, 1999

Patients *with* Osteoporosis

- Particularly those with history of minimal trauma fractures, poor balance, musculoskeletal problems or history of frequent falls

- Aims should be
  - Dietary intervention to correct undernutrition or micronutrient deficiencies
  - Avoid overconsumption of calcium-wasting agents (e.g. NaCl, caffeine)
  - If on bone sparing therapies, **extra nutrients to meet demands of new bone vitamin D, protein)**

(Goulding, 2003)

Elderly

- Calcium – role in fracture prevention regardless of presence of osteoporosis
- Calcium **and** vitamin D supplements for fracture prevention – especially in frail elderly (Avenell et al. 2005)

Fortified Milk in Practice

Average values per 200ml serving	Fortified Milk	Standard Whole Milk
Energy (kcal)	98	128
Protein (g)	6.8	6.6
Carbohydrate (g)	10.4	9.8
Fat (g)	3.0	7.0
Vitamin B12 (µg)	0.8	0.8
Calcium (mg)	**332**	**236**
Vitamin A (µg)	**240**	**104**
Vitamin B2 (mg)	**0.48**	**0.32**
Folic Acid (µg)	**140**	**12**
Vitamin D (µg)	**2.0**	**0.06**
Vitamin E (mg)	**3.0**	**0.18**

Fortified Milk Trials – Vitamin D & Calcium

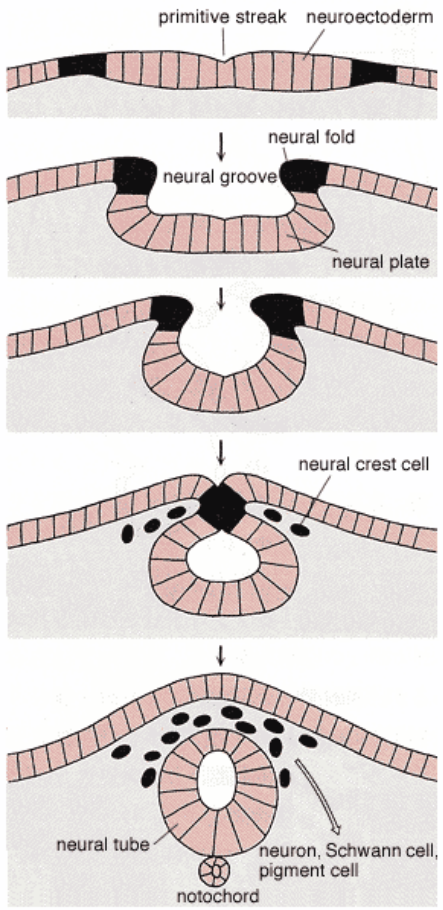
Subjects	Trial	Intervention group	Results	Reference
84yrs n=78 In-patients	3m RCT	>250ml vitamin D fortified milk	ñ 25(OH)D*	Keane et al. 1992
n=102 17-54yrs M & F	RCT	>2L fort milk/wk (3.4µg Vit D + 436mg Calcium /d)	Less seasonal ò in 25(OH)D*	McKenna et al. 1995
>66yrs n = 51 Free living	1yr RCT	500ml fort milk (5ug vitamin D)/d	ñ 25(OH)D* ñ calcium*	Keane et al. 1998
>50yrs men N=149 Free living	2yr RCT	400ml fort milk (1g Ca + 20ug Vit D/d	ñ 25(OH)D* ò PTH* ò bone loss	Daly et al., 2006

*(p < 0.001)

Finland

- Mandatory fortification of dairy with vitamin D since 2003
- Mean serum 25(OH)D conc during winter ñ by 50% (men 18-28yrs) (Laaksi et al. 2006)
- serum 25(OH)D conc ñ (4yr old children) (p=0.002) (Piirainen et al. 2007)
- Slight ñ in serum 25(OH)D during winter but not significant (18-21yrs) (Valimaki et al., 2007)

Neural Tube Defects



Neural Tube Defects in Ireland

- **Incidence**
  - 0.8-1.5/1000
- **Prevalence**
  - Increased incidence in families of Celtic and Irish heritage (genetic)
  - Increased incidence in families
- **?Prevention**
  - Peri-conceptual supplementation with folic acid can prevent up to 70% NTDs

Neural Tube Defects + Folate

Just 2% women aged 18-35yrs and 5% women aged 36-50yrs achieved RDA + 400µg supplement recommended for women of reproductive age 3

O'Brien et al., 2001

Neural Tube Defects + Folate

	Male	Female
Children (5-12 yrs)[1]	21	36
Adolescents (13-17 yrs)[2]	5	29

Figure. % inadequate intakes of folate, IUNA

[1] IUNA, 2005; [2]IUNA, 2008

National Committee on Folic Acid Fortification (FSAI, 2006)

- Mandatory fortification of flour
- All women of reproductive age + sexually active – additional 400µg supplement peri-conceptually until week 12 of pregnancy
- Consume foods fortified with FA + natural foods sources to meet RDA (300µg) for individual needs
- If on long term medication, discuss with doctor re. potentially higher FA requirements

Risk factors for low folate in practice

- Medications
  - Metformin
  - Low dose Methotrexate
  - Sulfasalazine
  - Anti-convulsants
- Malabsorption
  - Coeliac, Crohn’s

Folate and Elderly

- Likely widespread folate deficiency in elderly (11-28%) (Russell & Sutur, 1993)
  - Anaemia, cognitive impairment and depression
- Fortified milk study in elderly ward in SJH
  - Approx 200ml fortified (38µg/100ml) or unfortified milk/day
  - Significant increase in red cell folate in intervention group after 6m (Keane et al. 1998)

Fortified Milk in Practice

Average values per 200ml serving	Fortified Milk	Standard Whole Milk
Energy (kcal)	98	128
Protein (g)	6.8	6.6
Carbohydrate (g)	10.4	9.8
Fat (g)	3.0	7.0
Vitamin B12 (µg)	0.8	0.8
Calcium (mg)	**332**	**236**
Vitamin A (µg)	**240**	**104**
Vitamin B2 (mg)	**0.48**	**0.32**
Folic Acid (µg)	**140**	**12**
Vitamin D (µg)	**2.0**	**0.06**
Vitamin E (mg)	**3.0**	**0.18**

Summary

- Unbalanced diets in health & disease
- Widespread dietary inadequacies & evidence of deficiency
- Public Health Nutrition issues relevant to our patients, across the board
- **Fortified milk simple, convenient, cost effective way to contribute to nutrient intakes**

References_page 1

- Andersen R, Molgaard C, Skovgaard LT, Brot C, Cashman KD, Chabros E, Charzewska J, Flynn A, Jakobsen J, Karkkainen M, Kiely M, Lamberg-Allardt C, Moreiras O, Natri AM, O'Brien M, Rogalska-Niedzwiedz M and Ovesen L (2005) Teenage girls and elderly women living in northern Europe have low winter vitamin D status. *European Journal of Clinical Nutrition* **59**, 533-541
- Avenell A, Gillespie WJ, Gillespie LD and O'Connell DL (2005) Vitamin D a nd vitamin D analogues for preventing fractures associated with involutional and post-menopausal osteoporosis. *Cochrane Datatbase of Systemiatic Reviews* Issue 3. Art. No.: CD000227. DOI:10.1002/14651858.CD000227.pub2.
- *Codex Alimentarious Commission, 1987 General Principles for the Addition of Essential Nutrients to Foods CAC/GL 09-1987 (amended 1989, 1991).* Rome, Joint FAO/WHO Food Standards Programme (www.codexalimentarius.net/download/standards/299/CXG_009e.pdf)
- Daly RM, Brown M, Bass S, Kukuljan S and Nowson C (2006) Calcium and vitamin D3 fortified milk reduces bone loss at clinically relevant skeletal sites in older men: a 2 year randomized controlled trial. *Journal of Bone and Mineral Research* **21(3),** 397-405
- Goulding A (2003) Nutritional Strategies for Prevention and Treatment of Osteoporosis in Populations and Individuals, In *Nutritional Aspects of Bone Health,* pp. 707-732, New SA and Bonjour JP (eds.), RSC: Cambridge
- Hannon EM, Kiely M, Harrington KE, Robson PJ, Strain JJ and Flynn A (2001) The North/South Ireland Food Consumption Survey: mineral intakes in 18-64 years old adults. *Public Health Nutrition,* **4(5A)**, 1081-1088
- Hannon EM and Flynn A (2006) Contribution of fortified foods to nutrient intakes in Irish children aged 5-12 years. *Proceedings of the Nutrition Society* **65,** 34A
- Hannon EM, Kiely M and Flynn A (2007) The impact of voluntary fortification of foods on micronutrient intakes in Irish Adults. *British Journal of Nutrition* **97,** 1177-1186
- Hill TR, Collins A, O'Brien M, Kiely M, Flynn A and Cashman KD (2005) Vitamin D intake and status in Irish postmenopausal women. *European Journal of Clinical Nutrition* **59**, 404-10
- Hill TR, Flynn A, Kiely M, Cashman KD (2006) Prevalence of Suboptimal Vitamin D status in young, adult and elderly Irish subjects *Irish Medical Journal* **99**(2), 48-49
- Hill TR, Cotter AA, Mitchell S, Boreham CA, Dubitzky W, Murray L, Strain JJ, Flynn A, Robson PJ, Wallace JMW, Kiely M and Cashman KD (2008) Vitamin D status and its determinants in adolescents from the Northern Ireland Young Hearts 2000 cohort. *British Journal of Nutrition* Jan 15, 1-7 [Epub ahead of print]
- Irish Universities Nutrition Alliance (2001) North/South Ireland Food Consumption Survey. Full Report of Survey Data. http://www.iuna.net/survey_contents.htm
- Irish Universities Nutrition Alliance (2005) National Children's Food Survey. Personal Communication.

References_page 2

- Irish Universities Nutrition Alliance (2008) National Teens' Food Survey. Personal Communication.
- Keane EM, Rochfort A, Cox J, McGovern D, Coakley D and Walsh JB (1992) Vitamin D fortified liquid milk – a highly effective method of vitamin D administration for house bound and institutionalised elderly. *Gerontology* **38**(5), 280-284
- Keane EM, Healy M, O'Moore R, Coakley D and Walsh JB (1995) Hypovitaminosis D in the healthy elderly. *British Journal of Clinical Praxctice* **49**(6), 301-303
- Keane EM, O'Broin S, Kelleher B, Coakley D and Walsh JB (1998) Use of Folic Acid fortified milk in the elderly population. *Gerontology* **44,** 336-339
- Keane EM, Healy M, O'Moore R, Coakley D and Walsh JB (1998) Vitamin D fortified liquid milk: benefits for the Elderly community based population. *Calcified Tissue International* **62,** 300-302
- Laaksi IT, Ruohola JPS, Ylikomi TJ, Auvinen A, Haataja I, Pihlajamaki HK and Tuohimaa PJ (2006) Vitamin D fortification as public health policy: significant improvement in vitamin D status in young Finnish men (2006) *European Journal of Clinical Nutrition* **60,** 1035-1038
- McCarthy D, Collins A, O'Brien M, Lamberg-Allardt C, Jakobsen J, Charzewska J, Kiely M, Flynn A and Cashman K (2006) Vitamin D intake and status in Irish elderly women and adolescent girls. *Irish Journal of Medical Science* **175** (2), 14-20
- McKenna MJ, Freaney R, Byrne P, McBrinn U, Murray B, Kelly M, Donne B and O'Brien M (1995) Safety and efficacy of increasing wintertime vitamin D and calcium intake by milk fortification. *QJMed* **88,** 895-898
- National Dairy Council in association with The Irish Universities Nutrition Alliance (2002) The Role o f Dairy Foods in Health: a Report from NDC. Dublin: National Dairy Council http://www.ndc.ie/publications/images/milkreport.pdf
- O'Brien MM, Kiely M, Harrington KE, Robson PJ, Strain JJ and Flynn A (2001) The North/South Ireland Food Consumption Survey: vitamin intakes in 18-64 year old adults. *Public Health Nutrition* **4(5A),** 1069-1079
- O'Sullivan M, Nic Suibhne T, Cox G, Healy M and O'Morain C (2008) High prevalence of vitamin D insufficiency in health Irish adults. *Irish Journal of Medical Science* Feb 15 [Epub ahead of print]
- Piirainen T, Laitinen K and Isolauri E (2007) Impact of national fortification of fluid milks and margarines with vitamin D on dietary intake and serum 25-hydroxyvitamin D concentration in 4-year-old children. *European Journal of Clinical Nutrition* **61**, 123–128
- Royal College of Physicians (1999) *Osteoporosis: Clinical Guidelines for Prevention and Treatmen*t, Royal College of Physicians, London.
- Russell RM and Sutur PM (1993) Vitamin requirements of elderly people: an update. *American Journal of Clinical Nutrition* **58,** 4-14
- Valimaki VV, Loyttyniemi E and Valimaki MJ (2007) Vitamin D fortification of milk products does not resolve hypovitaminosis D in young Finnish men *European Journal of Clinical Nutrition* 61(4), 493-497