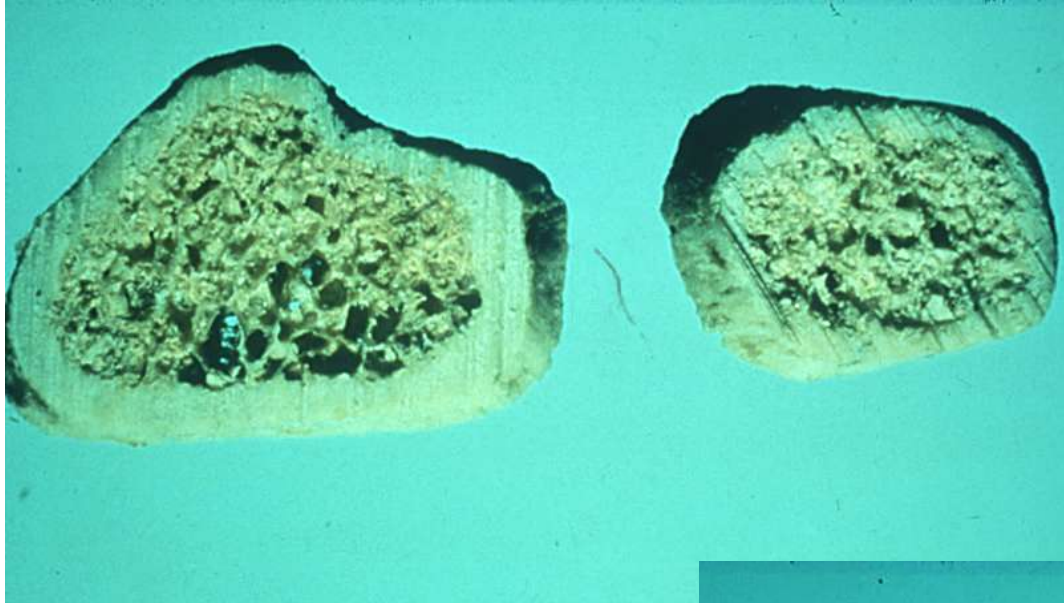


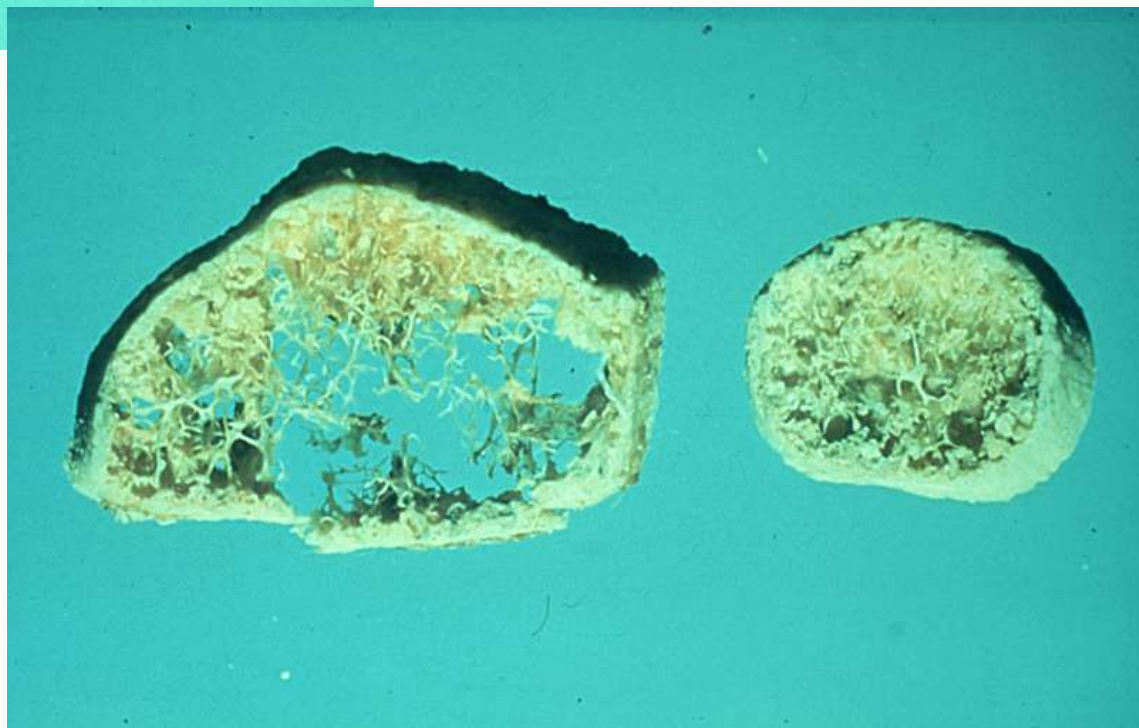
# Prevention of Fractures in Residential Care Facilities by Lifestyle Measures

Professor B.E.Christopher Nordin



**Normal**

**Osteoporotic**



**Fig. 1**

Control



Control



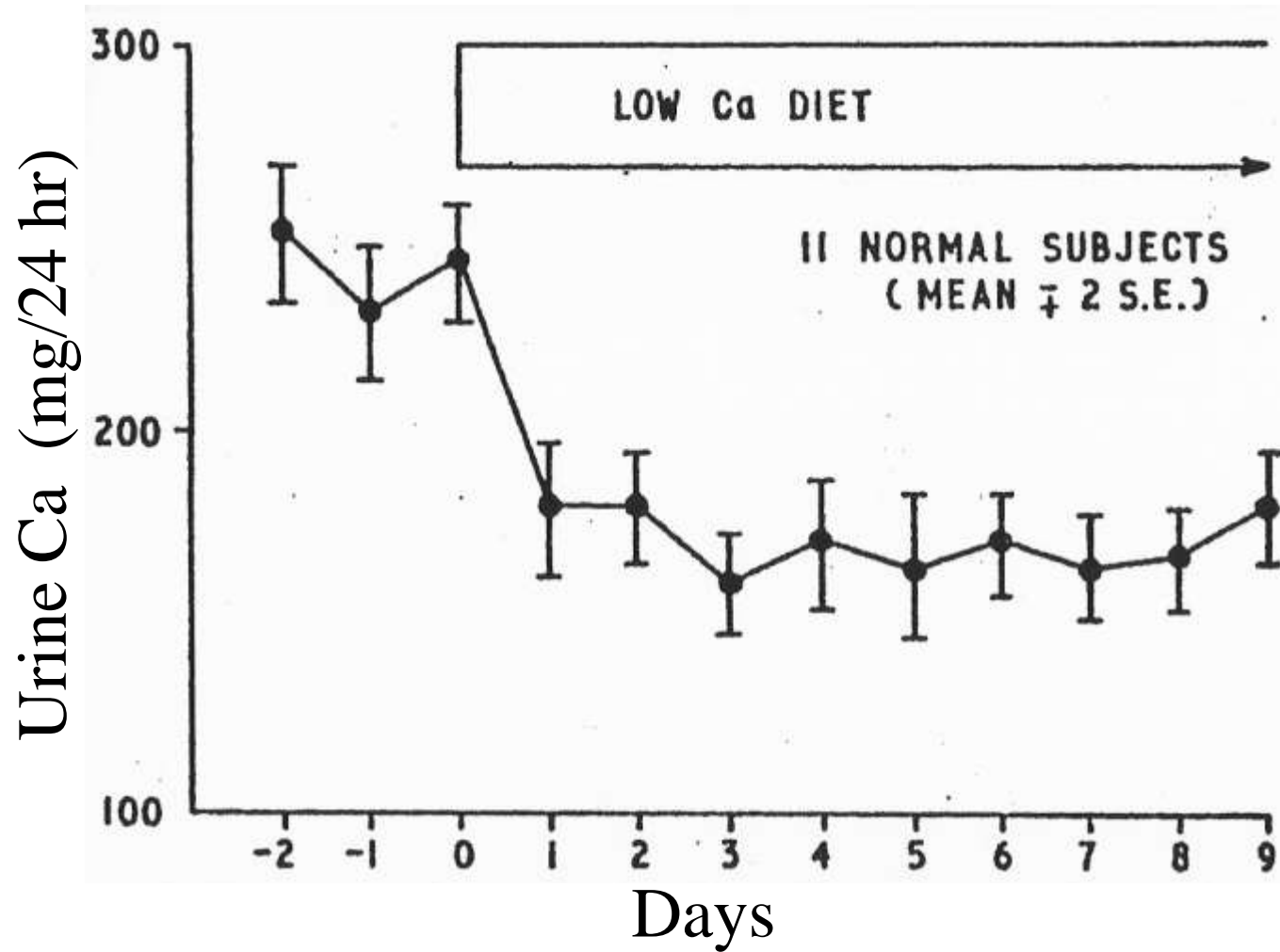
Low Calcium



Low Calcium



**Bauer, Aub & Albright (1929)**



Mean urinary calcium excretion in 11 normal subjects during 3 days on a ward diet and 9 days on a low-calcium diet.

(MacFadyen et al. (BMJ 1965))

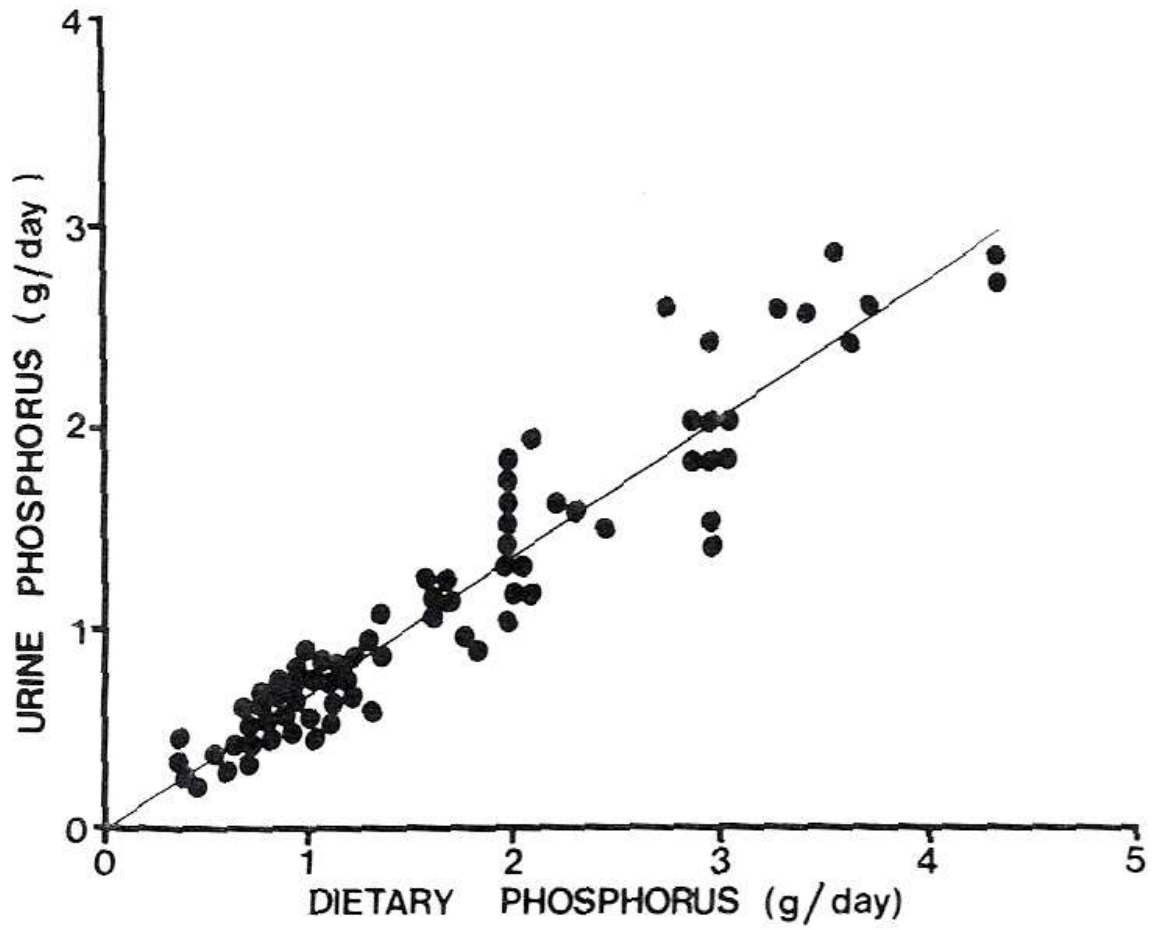
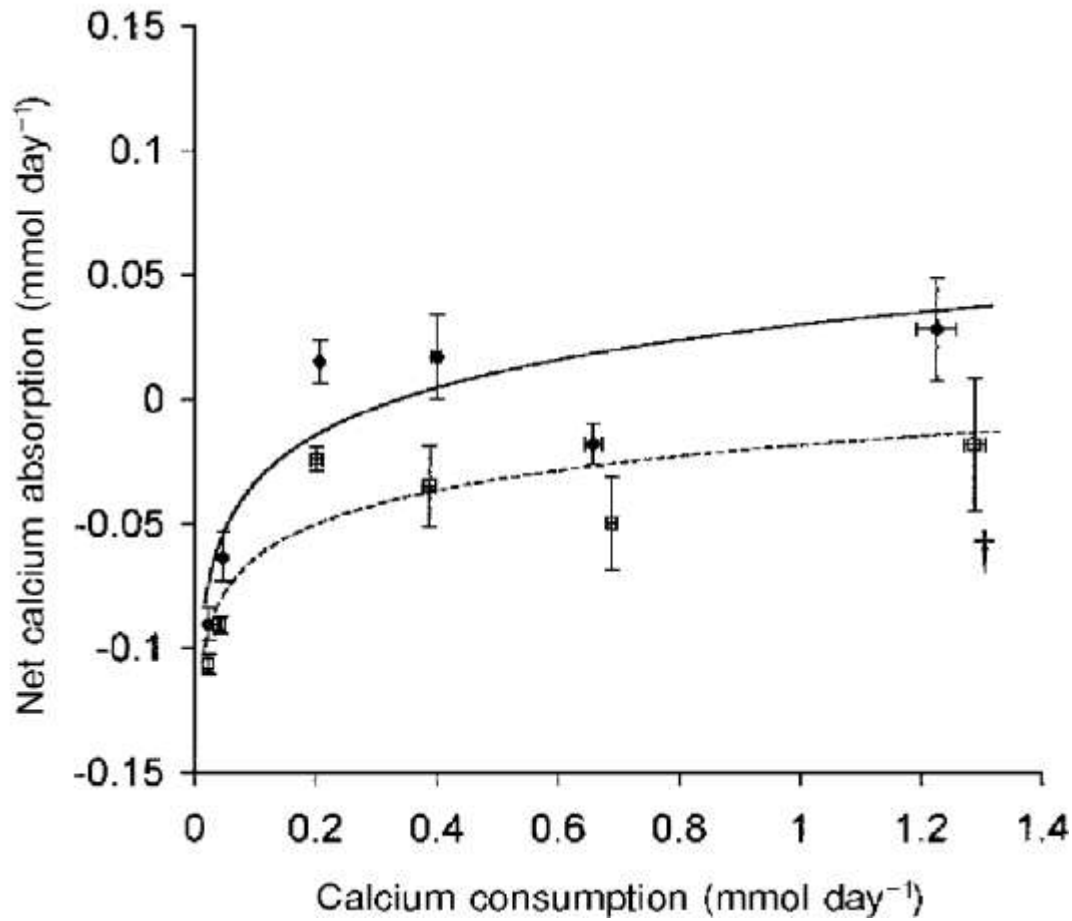


Fig. 3.19 The relation between urinary and dietary phosphate in healthy subjects.

# Mineral Homeostasis

	<b>Ca</b>	<b>Plasma</b>	<b>P</b>
Inter-individual	c.v. 2.1%		12.0%
Intra-individual	c.v. 1.3%		9.4%



The relation between calcium intake and absorbed calcium in intact rats (top) and oophorectomized rats (below)

# Effects of Oophorectomy in rats (means (se))

<u>Variable</u>	<u>Sham (162 obs)</u>	<u>OOX (132 obs)</u>	<u>P</u>
Ca/Cr	0.41 (0.025)	0.55 (0.033)	<.001
OHP <sub>r</sub> /Cr (x 1,000)	11.5 (0.2)	14.8 (0.3)	<.001

(Morris et al. 1995)

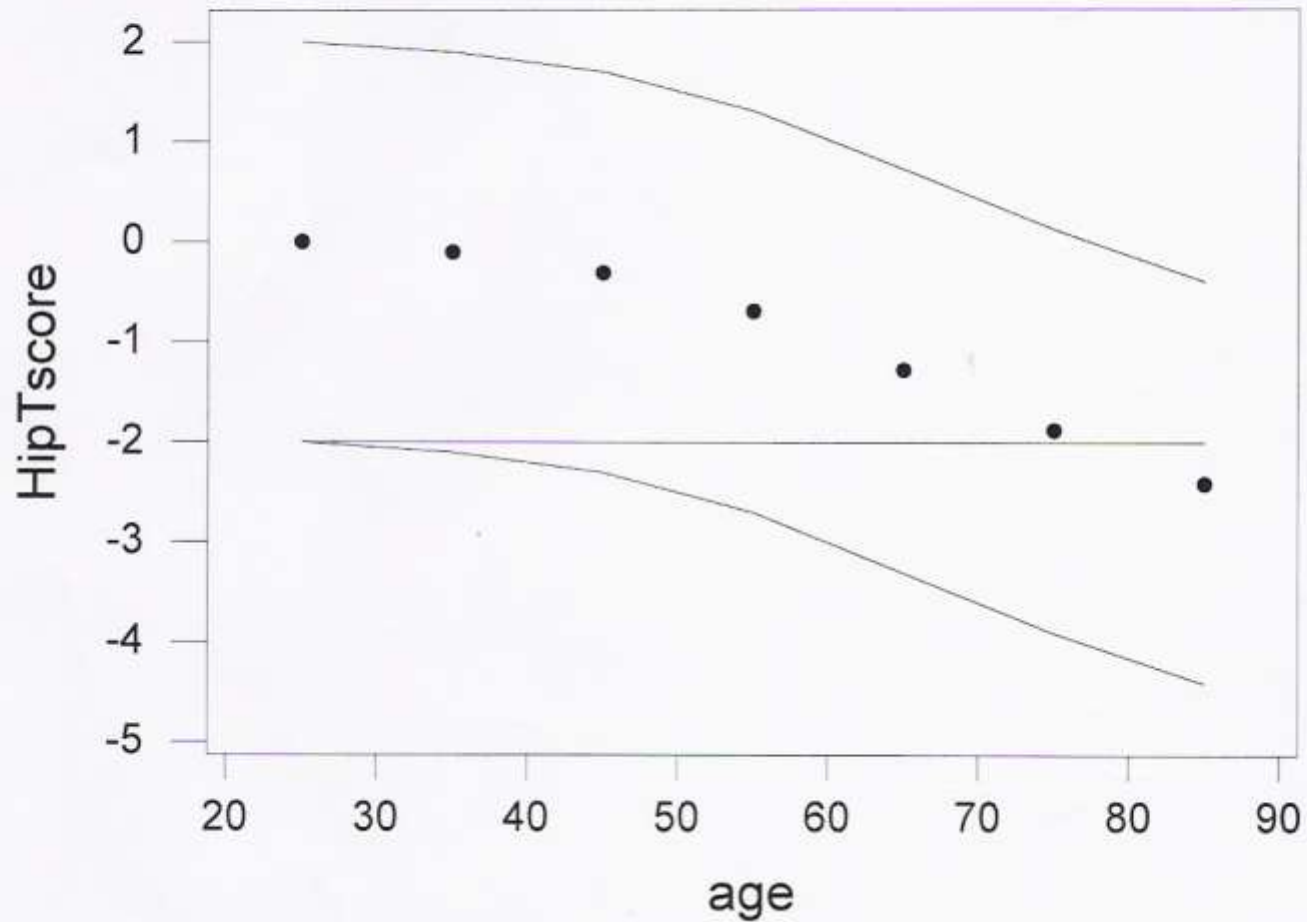
# **Ca<sup>45</sup> absorption, obligatory calcium and bone resorption in 34 women before and after menopause (Mean (SD))**

	<b>Pre-</b>	<b>Post-</b>	<b>'t'</b>	<b>P</b>
Ca abs (fx/hr)	0.78 (0.21)	0.64 (0.22)	4.0	<.001
Ca/Cr	0.16 (0.14)	0.34 (0.21)	5.3	<.001
DPyr/Cr	21.4 (5.2)	30.7 (7.9)	6.8	<.001

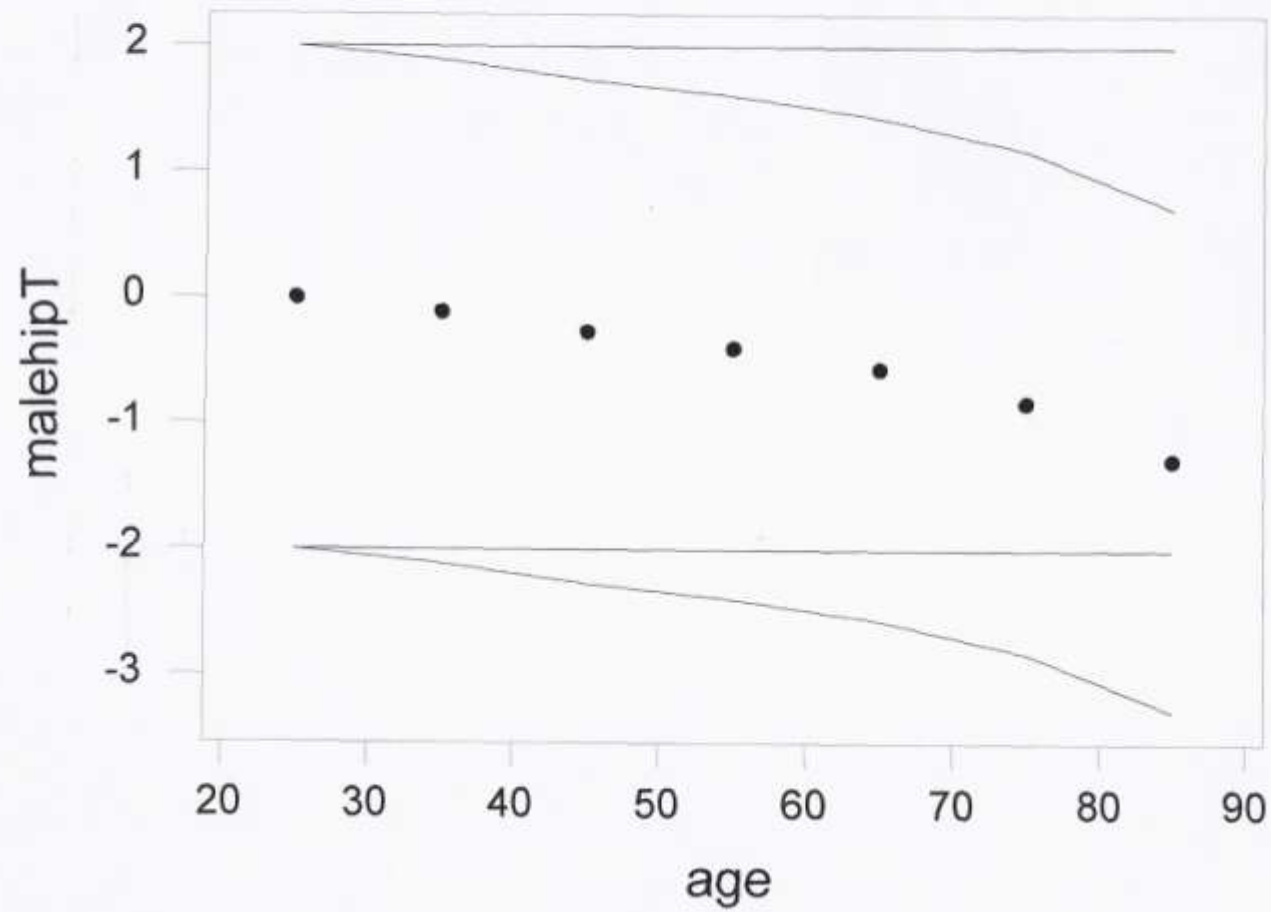
(Nordin et al. 2004)

**Panel 3**

# NORMAL WOMEN NHANESIII



# NORMAL MEN

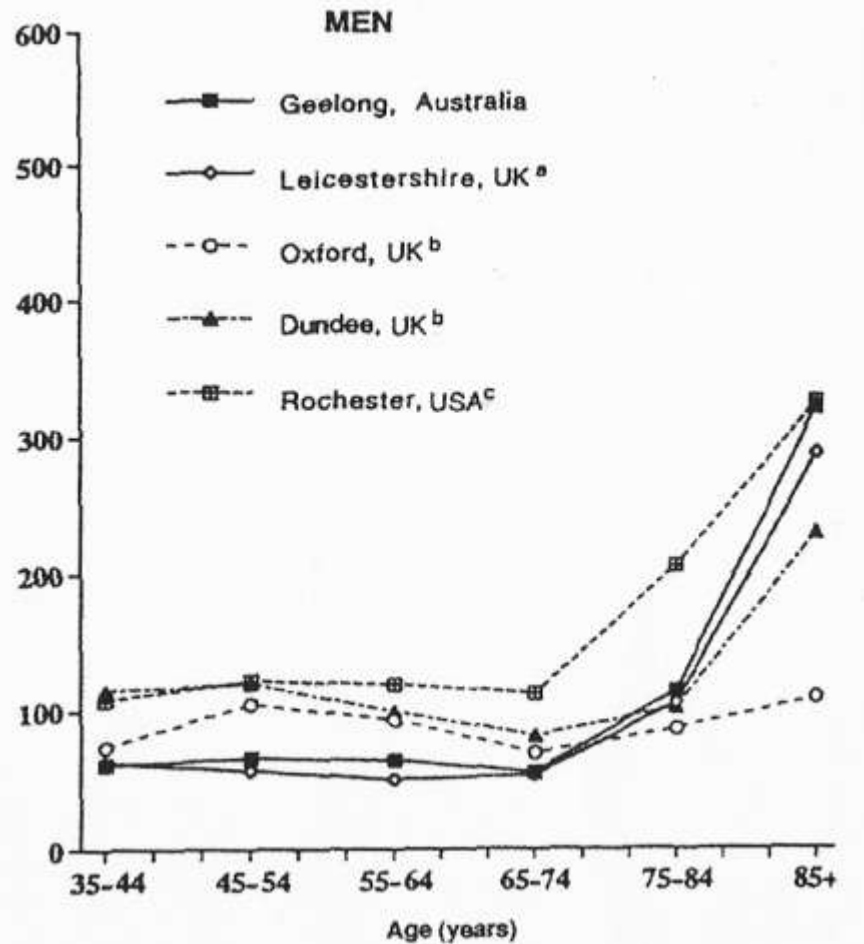
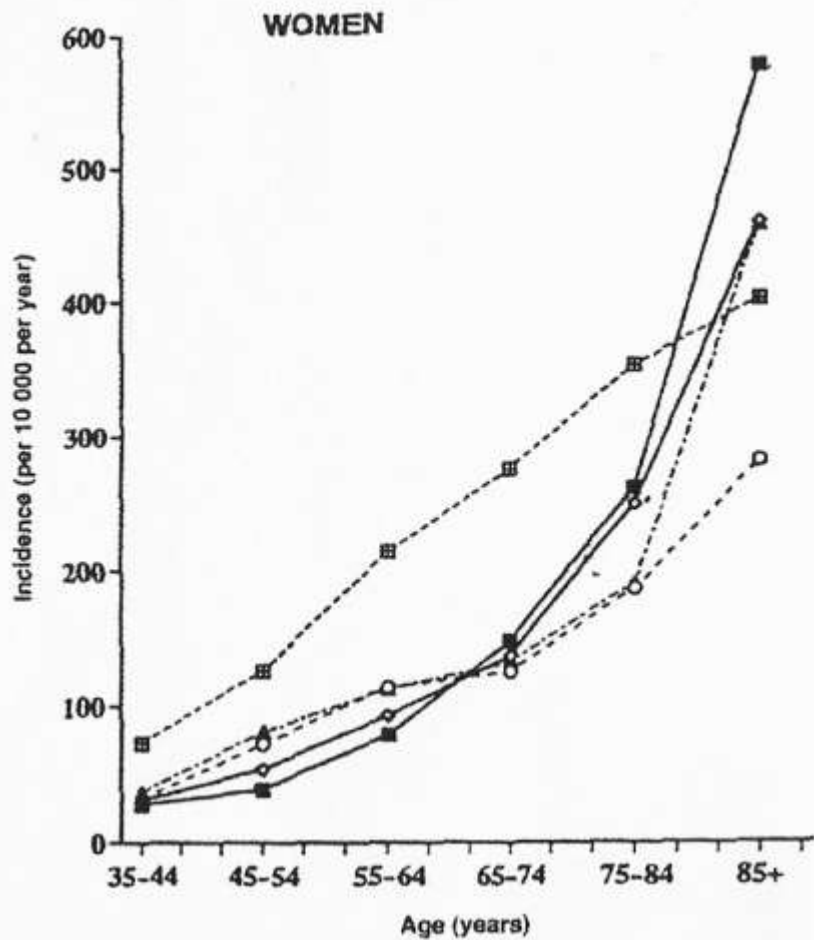


Young Female  
Hip BMD

.956 g/cm<sup>2</sup> (SD.125)

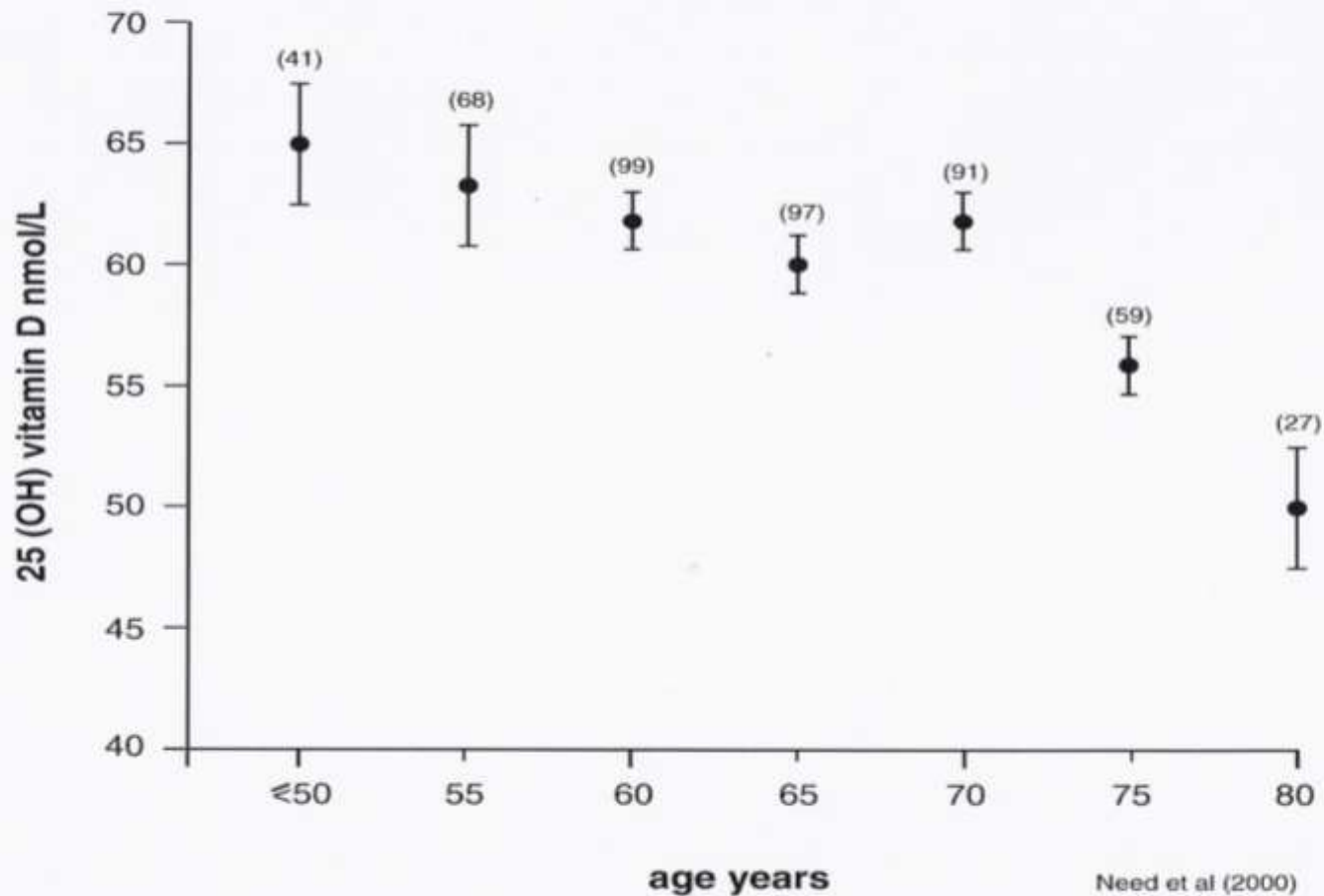
Young Male  
Hip BMD

1.135 g/cm<sup>2</sup> (SD.155)



Total fracture incidence in women and men  
(Sanders et al, 1999)

# 482 Postmenopausal women (without spinal fractures)



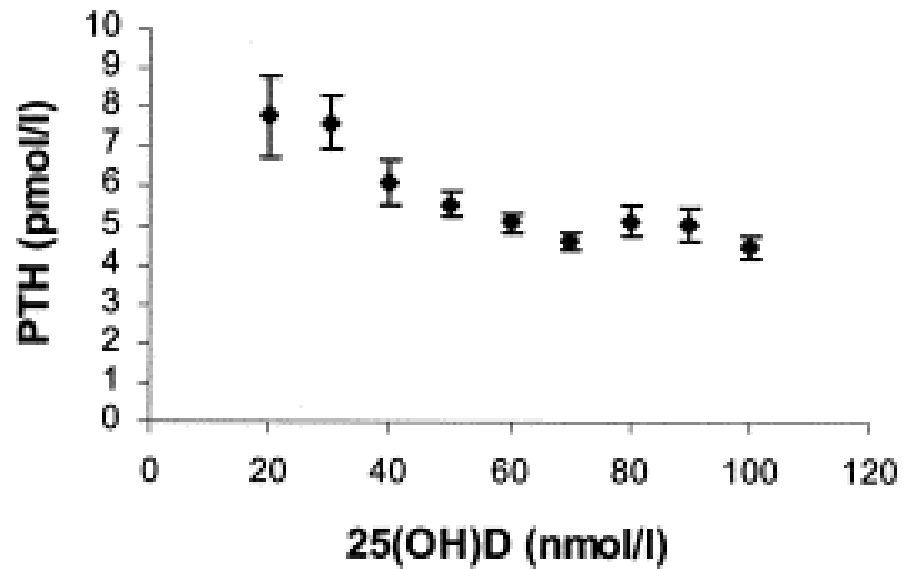
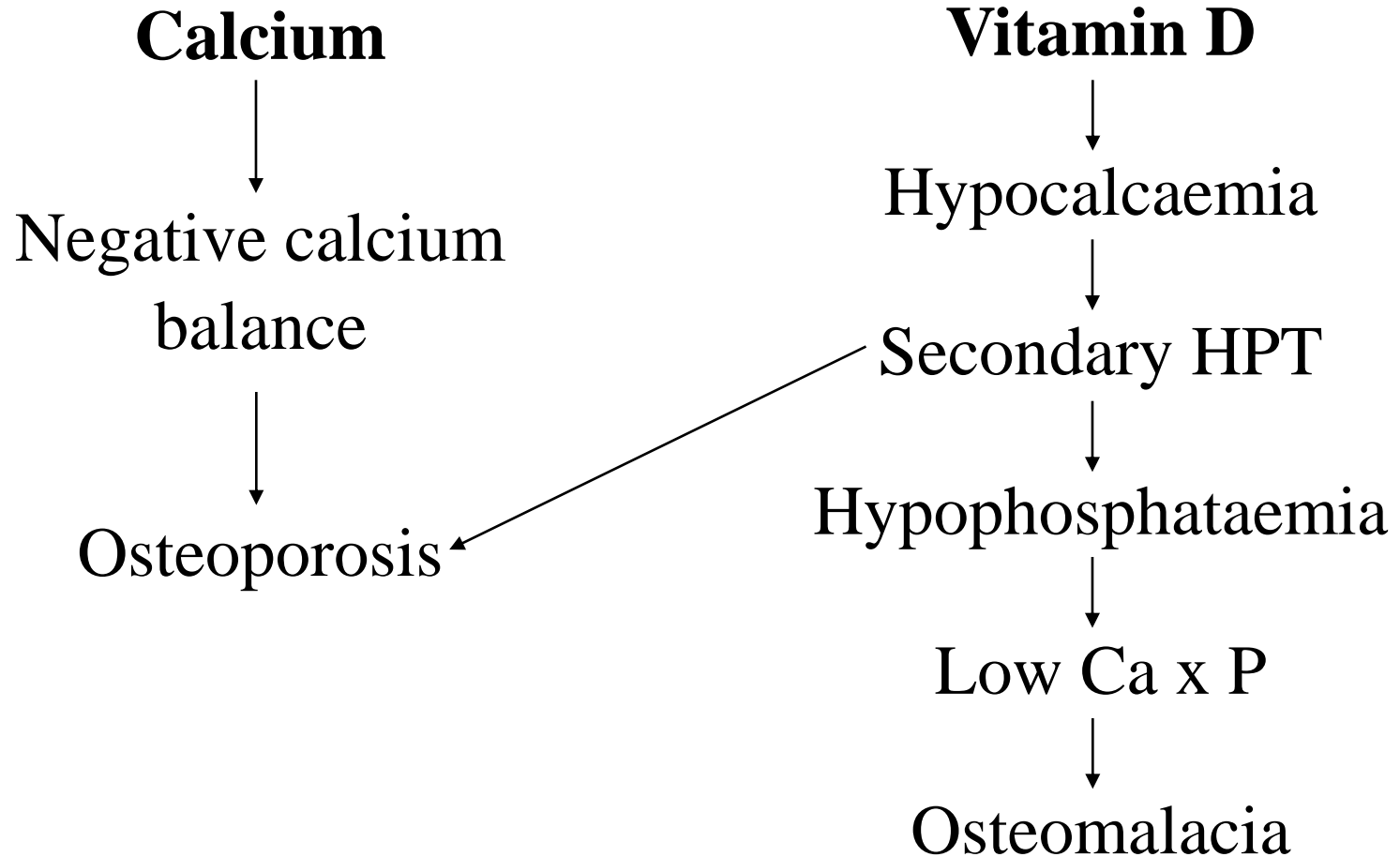


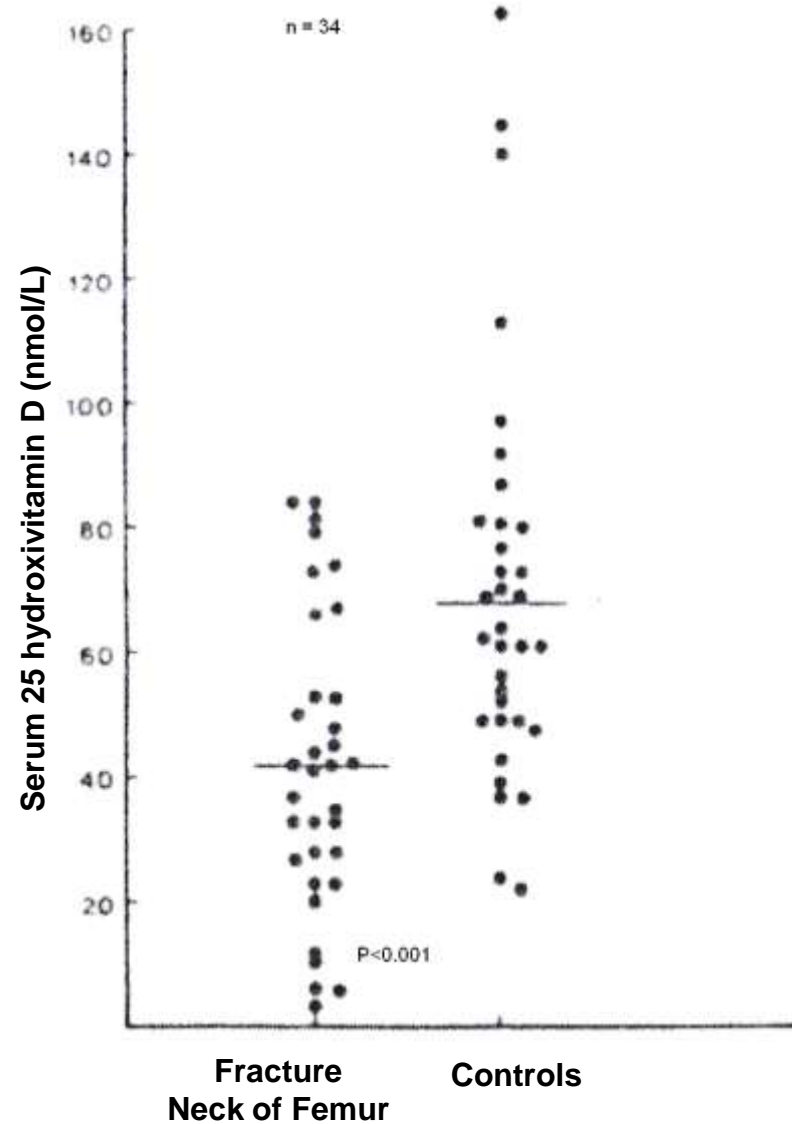
Figure 1. Relationship between serum PTH and 25(OH)D in 486 postmenopausal women.

	OHP <sub>r</sub> /Cr		Pyd/Cr		Dpd/Cr		ALP <sup>a</sup>		PTH	
	t	p	t	p	t	p	t	p	t	p
Divided at:										
20 nmol/L	0.95	0.36	1.10	0.29	1.12	0.28	1.14	0.27	2.7	< 0.05
30 nmol/L	2.14	0.04	1.56	0.13	1.13	0.26	2.76	< 0.01	4.5	< 0.001
40 nmol/L	2.64	< 0.01	2.01	0.05	1.14	0.25	3.06	< 0.01	4.3	< 0.001
50 nmol/L	2.64	< 0.01	2.65	< 0.01	1.68	0.09	3.14	< 0.01	4.6	< 0.001
60 nmol/L	3.46	< 0.001	3.76	< 0.001	2.05	0.04	4.25	< 0.001	4.3	< 0.001
70 nmol/L	3.07	< 0.01	2.46	0.01	0.94	0.35	2.33	< 0.05	2.7	< 0.01

Significance of differences in bone resorption markers above and below various 25OHD thresholds.

# Deficiency of





Serum OHD concentrations in 34 pairs of patients with femoral neck fractures and age-matched controls (Morris et al. MJA 1984)

Morris *et al*, 1984  
 (Med J Aust 140:519-521)

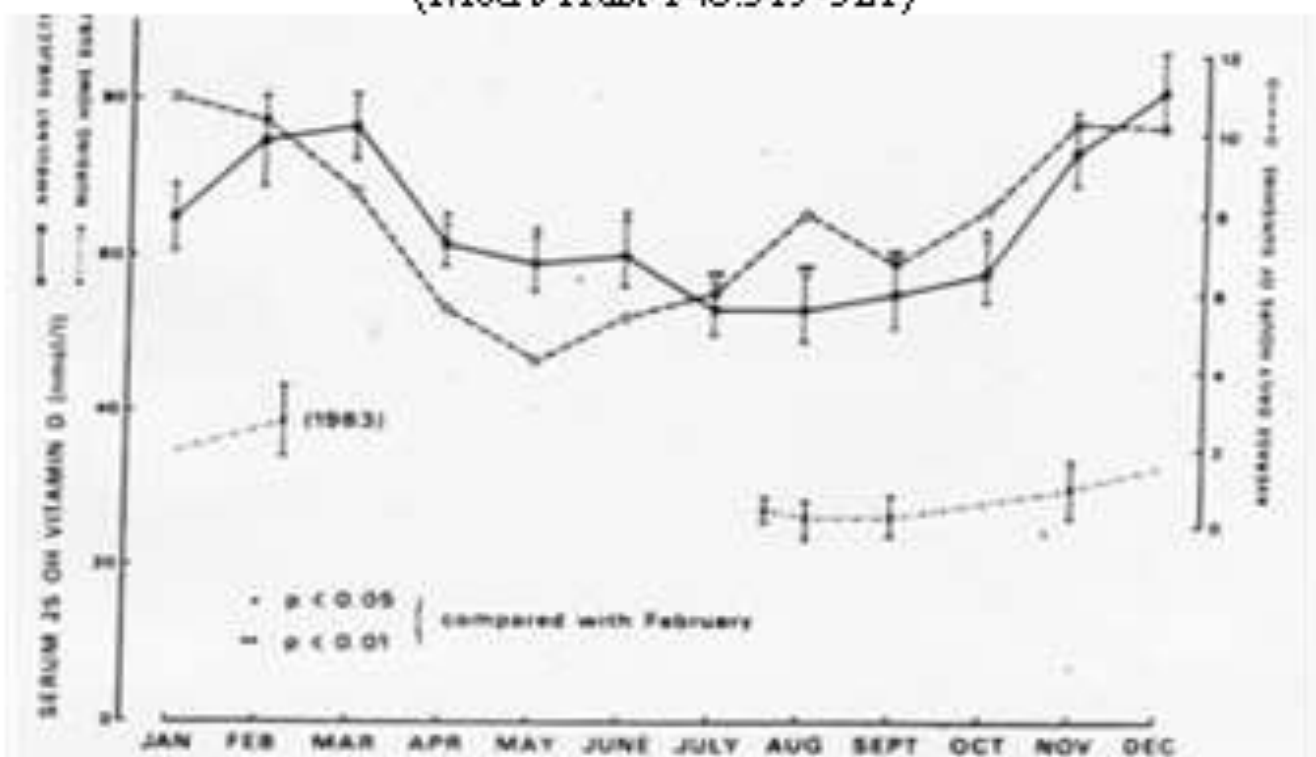


FIGURE 2: Seasonal variation (mean values  $\pm$  SEM) of serum 25OHD concentrations and daily hours of sunshine for Adelaide, South Australia, during 1982. Values indicated by • and •• have significance of differences  $< 0.05$  and  $< 0.01$ , respectively, when compared with the February value.

There are about 220,000 men and women over 65 in South Australia, about 2,000 of whom sustain hip fractures every year. About 600 of these occur in Nursing homes or Aged Care Facilities housing 13,000 residents (4.6%). The remaining 1,400 mainly come from their own homes, where 207,000 are living (0.68%).

$$\text{Relative risk} = \frac{4.6}{0.68} = 6.8$$

National total about 6,000

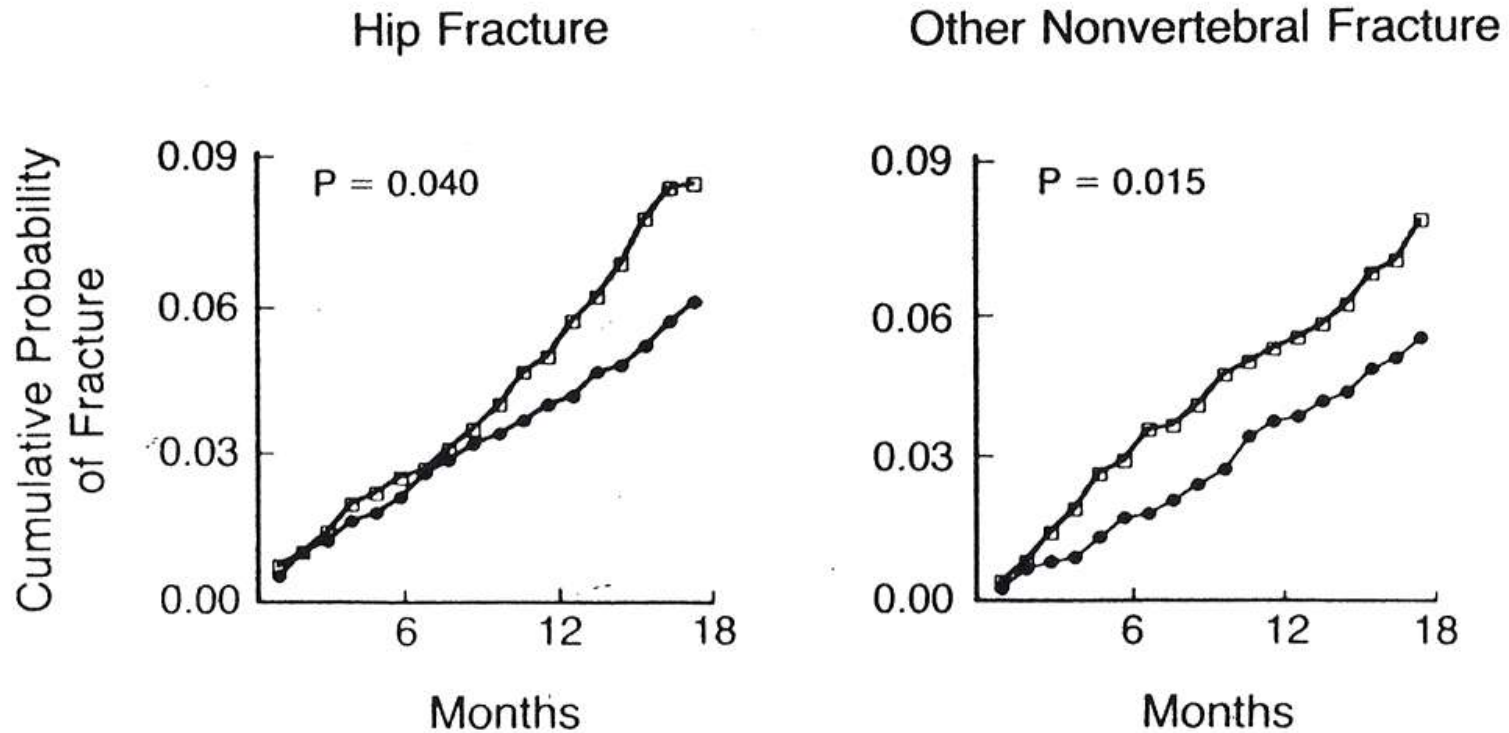


Figure 1. Cumulative Probability of Hip Fracture and Other Nonvertebral Fracture in the Placebo Group (□—□) and the Group Treated with Vitamin D<sub>3</sub> and Calcium (●—●), Estimated by the Life-Table Method and Based on the Length of Time to the First Fracture.

Chapuy et al. (NEJM 1992)

# Recommendations

The South Australian Department of Health Working party on Prevention of Osteoporosis and Fractures has recommended that all residents in aged-care facilities be given 1200mg daily of calcium as the carbonate or 500-600mg as the citrate (which is better absorbed) together with 800-1000 units of vitamin D3. They also recommend that the same treatment be offered to women over 65 in the community.

# Options for Aged Care

	Vitamin D	Calcium	Dosage
Ostelin			
Vit D + Ca	500 units	600 mg	1 b.d.
Citracal +D	500 units	315 mg	1 b.d.
Calvid	880 units	1,000 mg	1 o.n.
Calsource + D <sub>3</sub>	800 units	1,200 mg	1 o.n.
Ostevit-D & Ca*	500 units	600 mg	1 b.d.

\*chewable

Intermittent high dose vitamin D should be discouraged because it is ineffective in fracture prevention and neglects the role of calcium.

# People in Residential Aged-Care facilities – number receiving daily calcium or vitamin D supplements – January 2011

## Compliance

13 Residential Care Facilities

680 Residents

306 on calcium and vitamin D supplements

**= 44.6%**

# The Problems

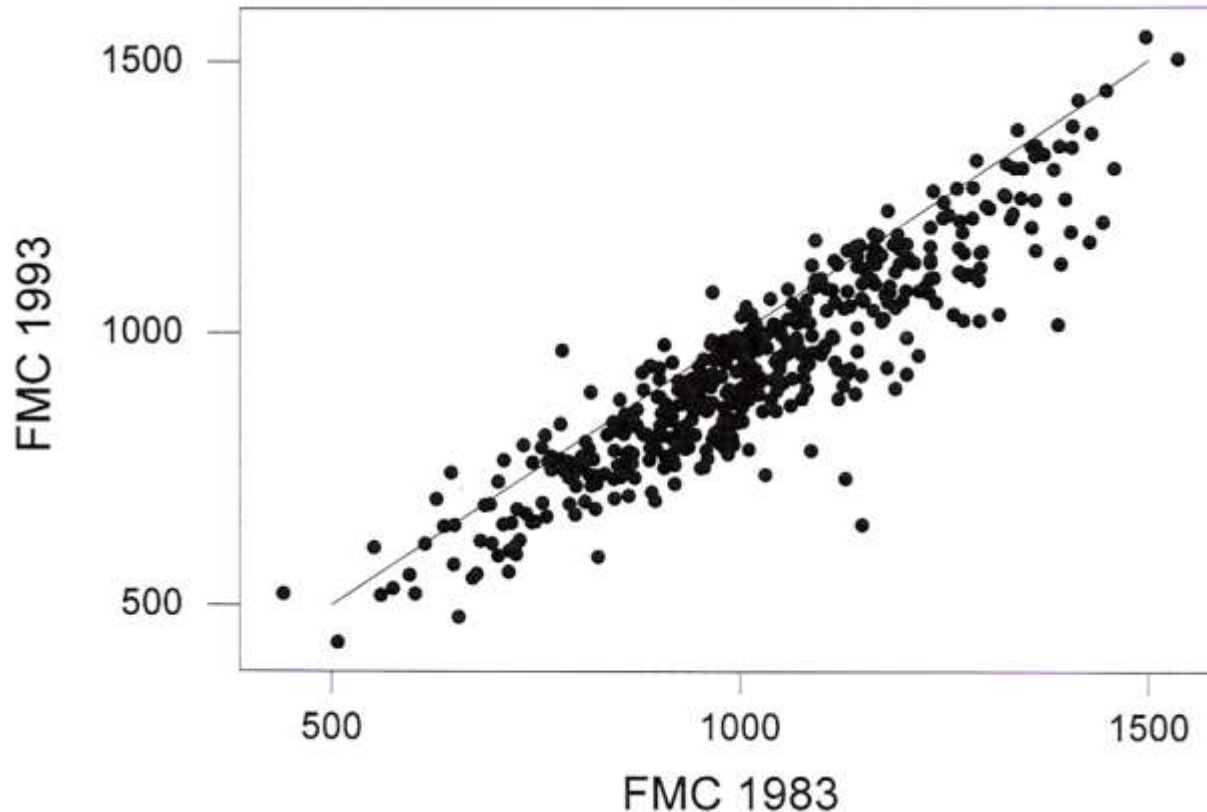
Although vitamin D and calcium are over-the-counter products, they require ordering by a doctor.

Although they are dietary supplements, they have to be paid for by the resident.

# Possible Solutions

- Use of fortified milk at bedtime to provide calcium
- Bulk purchase of vitamin D by Residential Care Facilities.
- Provision of high-calcium milk fortified with vitamin D

Forearm mineral content (mg/cm) in 454 normal postmenopausal women in 1983 and 1993 ( $R^2 = 82\%$ )



The line of equality is shown. Note that although they lost bone at different rates, the main determinant of FMC in 1993 was the value 10 years earlier.

# A single bone density measurement can predict fractures over 25 years

Düppe et al. (Calcified Tissue Int 1997)

## **Relative Risk per BMD SD (inverse)**

Hip 1.66 (1.33-2.46)

Vertebral 1.79 (1.22-2.67)

Any 1.33 (1.20-1.73)

# Meta-analysis of 68,517 patients from 7 trials

D + Ca	HR 0.92 (.86-.99)	P.025
10 $\mu$ g D + Ca	HR 0.74 (.60-.91)	P.005
D alone		ns

Abrahamsen et al. (BMJ 2010)

# Proposal

To provide bone densitometry to all women at menopause, identify those with low-normal values (negative T-scores), and seek to prevent their loss of bone by advice on diet (adequate calcium and vitamin D, restricted salt and animal protein), exercise and other relevant measures.