Age Matters! Greater Bone Loss with Weight Reduction with ↑ Age

Controlled wt loss trials: Avenell ’94, Ricci ’01, Salamone ’99, Shapses ’01, Svendsen ’94; Redman ‘08
Bone turnover increases during weight loss: Ca supplementation.

Ricci ‘98 and ’01 (Ca intake 550 vs 1600 mg/d)

Bone resorption > than the in formation
Hormonal changes with Wt loss
postmenopausal women (1 g or 1.7 g Ca/d)

Differs from baseline, *p < 0.05, †p < 0.1
No rise in cortisol in Premenopausal women during wt loss

Riedt ‘05
Reduced Fat Mass is Associated with Lower Circulating Estrone
(Overwt postmenopausal women n=53)

Riedt CS et al., JBMR ’05, Ricci AJCN ’01
Serum PTH increases more during weight loss in Post- than Pre-menopausal Women

Shapses ’01, Ricci ’01
Glucocorticoids during Weight Loss

Cortisol response in postmenopausal women. Riedt C, JBMR 2005

No effect of cortisol in premenopausal women; Riedt AJCN '07

Cifuentes, M J Nutr ‘04
Ca absorption:
dual stable isotope method

MASS SPEC methods developed at Rutgers.
Precise and accurate determination of calcium isotope ratios in urine using HR-ICP-MS
Ca Absorption is Reduced with Caloric Restriction in Postmenopausal Women: 36% explained by PTH and E$_2$ (\(^{43}\text{Ca}\) and \(^{42}\text{Ca}\))

Cifuentes et al. AJCN ’04

Premenopausal women (Riedt et al, ‘07)
Another nutrient & bone: Why protein?

- **Effect on Bone:**
  - Negative: Low grade acidosis, ↑ Ca excretion, hi pro Western diet = low BMD
  - Positive: ↑ Ca absorption, adequate Ca is important
    ↑ pro in elderly= higher BMD

- **Weight loss and pro:**
  - Old rat at 2 levels of pro (13 vs 26%) and caloric restriction = no difference in bone loss (Mardon J ’08).
  - Most studies =2 levels of pro, but do not control for Ca intake.
  - Our goal: 2 levels of protein while controlling for Ca intake

*Conigrave, Brown & Rizzoli Ann Rev Nutr ’08; Heaney and Layman ’08; Kerstetter J articles; Dawson-Hughes articles*
Bone Mass after Gastric Bypass Weight Loss Surgery

Fleischer JCEM, 2008 found that hip bone loss was proportional to weight loss; no rise in PTH at 6 or 12 mo (high Ca and 1700 IU/d vitamin D intake with no change in serum 25OHD)

Coates PS ‘04
Bone Changes 4 years after RYGB Surgery in Postmenopausal Women
(n=42, age and weight matched control group)

BMC - Femoral Neck

BMC - Lumbar Spine

No differences found for premenopausal (n=21; not shown)

Goode L et al, 2004
TFCA and Gastric Bypass

21 women (44 ± 10 yrs) who lost 38 ± 8 kg

TFCA = true fractional Ca absorption

*p<0.0001

Riedt C, Obesity, 2006
High PTH and Bone Resorption
4 Yrs after Weight Loss Surgery

RYGB women compared to weight matched controls.
Values means + SD
Differs from RYGB (ANOVA): *p<0.001

Goode L et al, 2004
Moderate Energy Restriction
Healthy Postmenopausal woman

↓ Estradiol  
17B E2 ⇔ ↓

↓ Ca Absorption

↓ Bone Resorption

↑ PTH

↑ Cortisol

↓ Leptin, GH, IGF-I, glucagon like peptide-2

Osteoblast ⇔

↓ Bone formation

(The balance of hormonal change is also dependent on age, gender or amount/type of weight loss, etc.)
What is the big picture?

- Obesity is a problem and dieting is prevalent
- Bone loss (1-2%) with weight reduction (10%) in older women (data in men is less clear). At younger age (< 45)... bone density resistant? Bone quality?
- For children....??? Studies are needed
- Can diet composition during dieting influence the hormonal milieu to ultimately affect bone & quality?