Calcium requirements in adolescents: discoveries from Camp Calcium

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Calcium Requirements in Adolescents: Discoveries from Camp Calcium

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Half of women over age 50 will have a fracture.

World wide cost of hip fracture - $131 billion

Maximizing Bone Mineral Content

Reduces Risk of Fracture

Calcium storage in bone is a functional reserve

http://www.ohsuhealth.com/dch/health/orthopaedics
BONE MASS

Adequate Calcium Intake

Inadequate Calcium Intake

Menopause

Fracture Zone

HEREDITY

EXERCISE/LOADING

CALCIUM INTAKE

STRUCTURAL ERRORS
Adolescence: Period of Rapid Bone Accretion

Girls
Boys

Total body bone gain gm/yr

Age in Years

Bailey, et al., JBMR 14:711, 1999
Risk taking or low bone density?

High rate of fractures during early puberty
Transient Low BMD for Size

Size-adjusted BMD

BMD = bone mineral density (g/cm²)

Faulkner et al., J Bone Miner Res 2006;21:1864
Incidence of Distal Forearm Fractures in Adolescents has Increased

Khosla et al., JAMA 2003;290:1470
Camp Calcium
Metabolic Studies in Adolescents
How much Calcium?

Funded by NIH (NIAMS)
Camp Calcium Studies

• 10 metabolic balance studies, 1990 to 2007
• Adolescent boys and girls
• **Controlled** diets for 3 week metabolic balance periods
• Urine and fecal collections pooled by 24h
• Calcium retention (mg/d) =
  \[ \text{Ca intake (mg/d)} - \text{Urinary Ca}^* \text{ (mg/d)} - \text{Fecal Ca (mg/d)} \]

*creatinine-corrected
Impact

Data determined the calcium requirements for adolescents for North America – 1997

Used for 2004 Surgeon General’s Report on Bone Health

Used for 2005 Dietary Guidelines
Study Design

Controlled diet
*High* or *Low* Ca

Crossover

Washout

Controlled diet
*High* or *Low* Ca

Metabolic Balance

Metabolic Balance
Maximal Calcium Retention as a Function of Intake

\[ \% \text{ Maximum Retention} \] vs. \[ \text{Intake (mg/day)} \]

Over 1 year, represents gain of 4\% skeleton

Jackman et al., AJCN, 1997
Intestine

Vi

Intake

absorption

V_a

V_f

V_F

tecal

Kidney

V_u

urine

Bone

Bone formation

V_o+

V_o-

Bone resorption
Collaborators

Purdue University
  Nutrition studies
  Chemistry – calcium tracer analysis
Indiana University School of Medicine
  Biochemistries
New Zealand
  Kinetic modeling
Add on studies – internal, external
Issues

Data sharing

-internal files stored on personal drive of College server not accessible to other collaborators

-external -NIH requires

  Pooling of data over studies from 1990 to present

  ~500 subjects

  30 primary assays – some for 6 weeks

Subject de-identification

Intervention blinding