Adolescent/Early Adulthood: Establishing Reserve/Affecting Late-Life Risks

PROMOTING HEALTHY AGING THROUGH NUTRITION

SARAH WHERRY, PHD

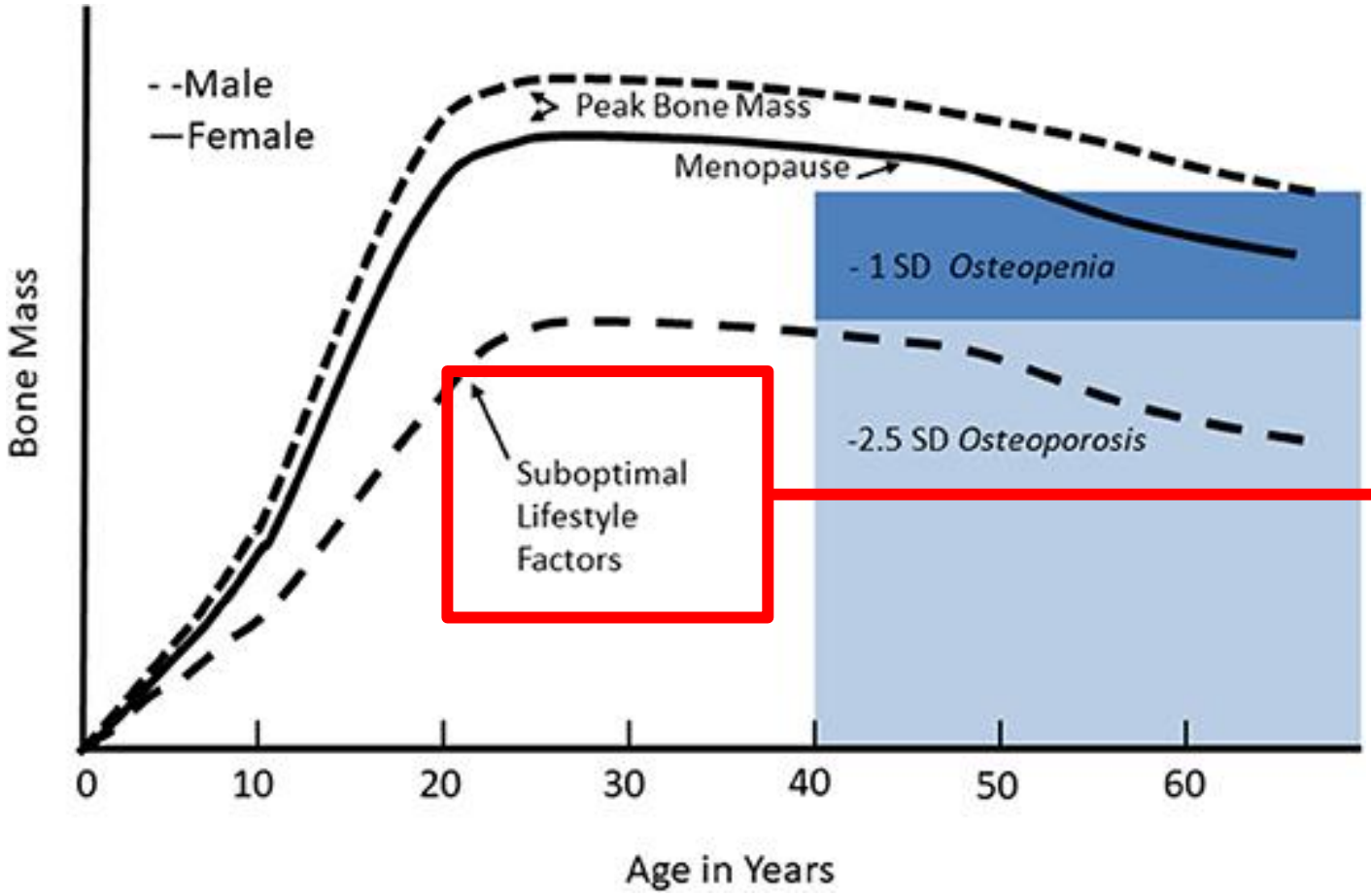
ASSISTANT PROFESSOR, UNIVERSITY OF COLORADO ANSCHUTZ MEDICAL CAMPUS

7/20/2023

Introduction

- Proper nutrition during adolescence and early adulthood is essential for normal growth and development
- All organ systems benefit from appropriate nutrition in childhood through late-life, and many tissues can continue to adapt to nutritional intake after development
- A unique organ system – the skeleton – is heavily influenced by lifestyle factors in adolescence and early adulthood that contribute to the risk of osteoporosis later in life
  - “A pediatric disease with geriatric consequences”
  - Bone remains responsive to nutrition after development, but greatest contribution occurs during growth and development

Introduction



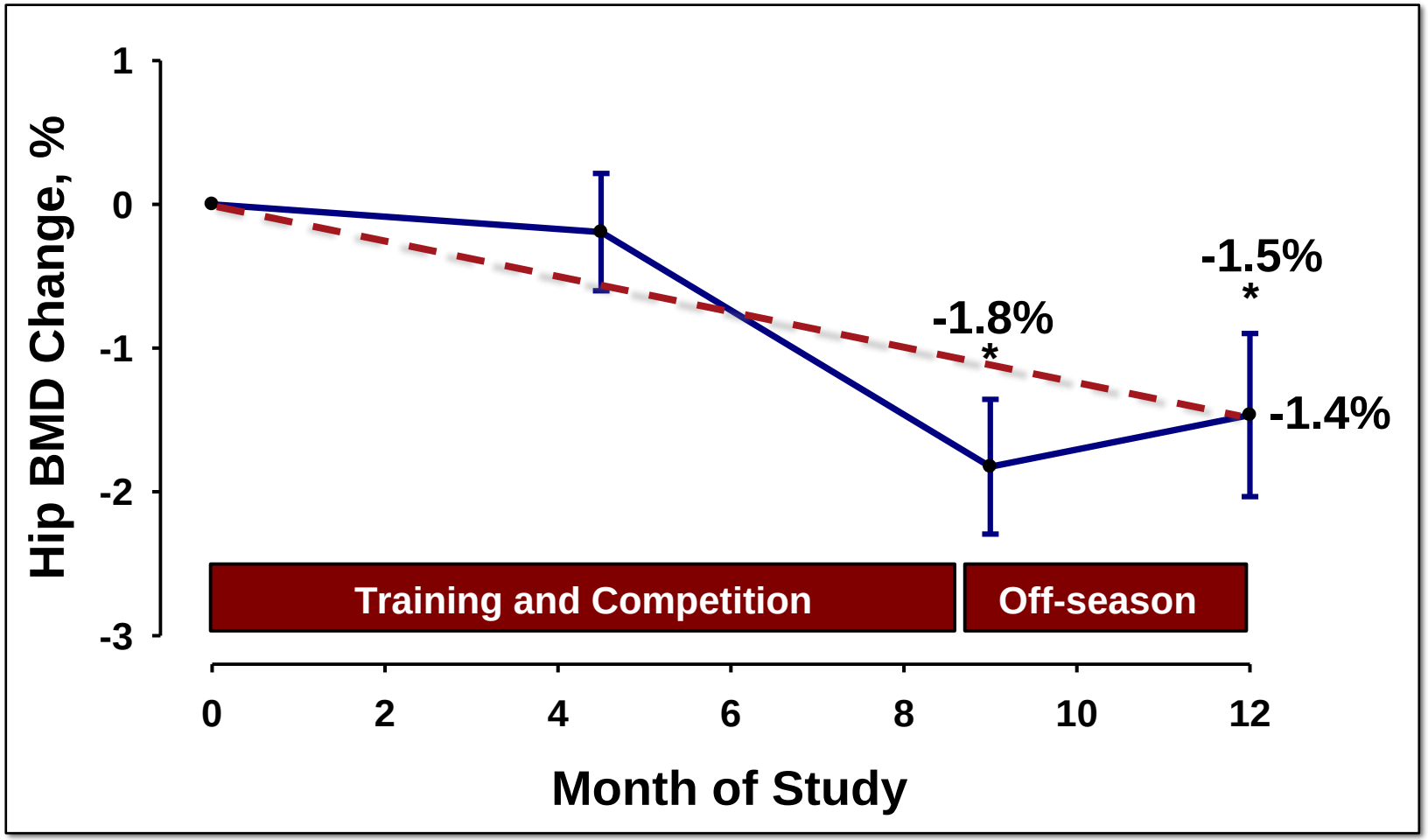
Poor Nutrition
Insufficient Physical Activity

Kralick, et al. PMID: 32194504; PMCID: PMC7064470

Current State of the Research

- Role of adequate intake of calcium and vitamin D during growth and development well-established
  - Additional micronutrients with at least some evidence of benefit:
    - Vitamin K (believed to increase osteoblasts and decrease osteoclasts)
    - Magnesium (may reduce calcium loss via the urine)
    - Potassium (may reduce calcium loss via the urine)
    - Boron (may reduce calcium loss via the urine)

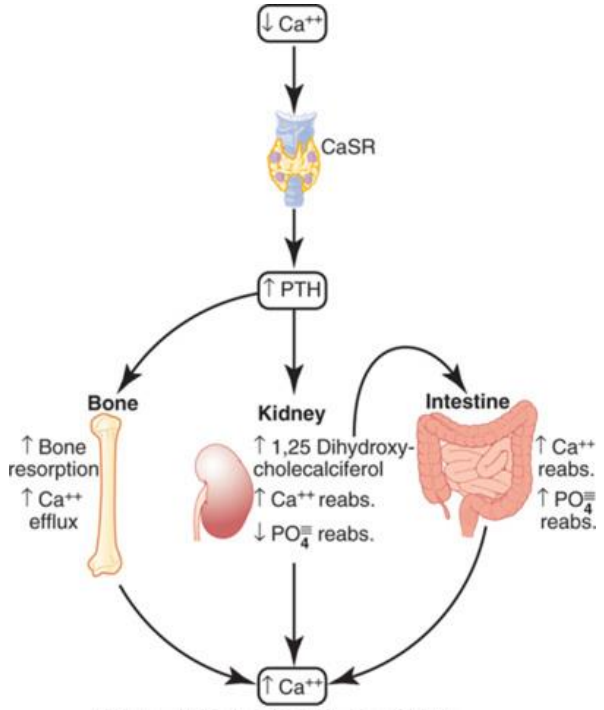
- Physical activity also appreciated as an essential component in the achievement of peak bone mass
  - Bone is a mechanosensitive tissue and responds to the load experienced
  - Greater load = greater bone mass
  - **BUT** some evidence that exercise can lead to bone loss under certain conditions



Adapted from: Barry DW, Kohrt WM *J Bone Miner Res* 23:484, 2008; Sherk VD et al *Clin J Sports Med* 24:331, 2014

Current State of the Research

- Impact of calcium homeostasis:
  - Exercise can cause a decrease in serum ionized calcium → activates bone resorption → if occurs over multiple exercise bouts, could lead to bone loss over time

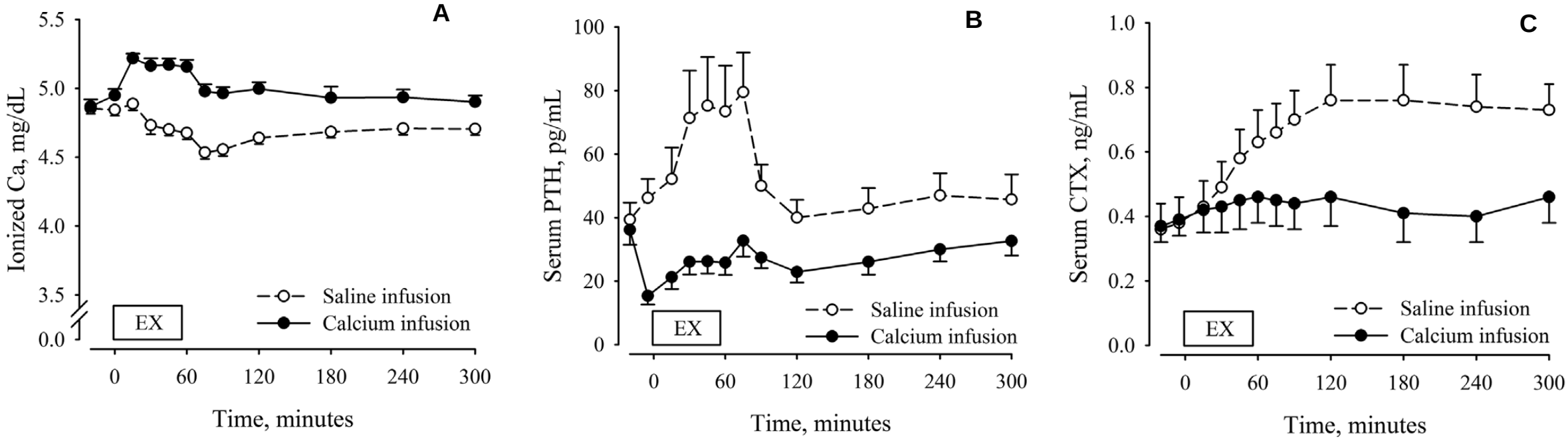


Guyton and Hall Textbook of Medical Physiology, 12th Ed. 2011.

Current State of the Research

- Dietary Calcium:
  - Several studies have demonstrated that at least 1000mg of calcium provided >30 minutes before the start of exercise necessary to see an attenuation in the activation of bone resorption
    - Studies have provided calcium as a beverage, chew, or meal; no one delivery method appears superior

- “Calcium Clamp”:
  - In young men during an hour of vigorous cycling exercise, ~120mg of calcium needed to be infused during exercise to prevent the decrease in serum ionized calcium
    - Partially attenuated the activation of bone resorption



Adapted from: Kohrt et al., 2018, *JBMR* 33:7, 2018

Current State of the Research

- Interrelationship Between Calcium and Exercise
  - Regular weight bearing exercise necessary during development and throughout adulthood to achieve peak bone mass and maintain bone health **AND**
  - Proper calcium intake essential for the health of the skeleton throughout the lifespan **AND**
  - Exercise may be disrupting calcium homeostasis

- Calcium needs may need to be adjusted for people who are highly physically active
  - Considerations for both amount of calcium and timing relative to exercise
  - Likely also needs to be adjusted based on exercise type, duration, frequency (and age of exerciser)

Major Gaps/Future Studies Needed

- All data on the exercise-induced disruption in calcium homeostasis has occurred in adults
  - Unclear of the implications in children during growth and development
  - Interaction with relative energy deficiency in sport (RED-S)?
    - Some athletic populations have impaired bone health due to RED-S

- Studies have been cross-sectional and endurance exercise only
  - Unclear on the effect of exercise training
  - Not known if resistance exercise or interval-type exercise can also activate bone resorption in response to a disruption in calcium homeostasis

Major Gaps/Future Studies Needed

- Should calcium supplements be taken prior to exercise?
  - Parathyroid hormone (PTH) has paradoxical actions on bone
    - Chronically elevated PTH = catabolic to bone
    - Intermittent increase in PTH = anabolic to bone
  - Bone **remodeling** is a coupled process where formation follows resorption
    - Exercise-induced bone resorption may lead to increased formation later on
    - May be different for children who are primarily experiencing bone **modeling** versus remodeling (i.e., bone resorption stimulus not essential for bone formation)

Thank You!

Questions?