Objectives

• Understand the causes and prevention of rickets and vitamin D deficiency in Alaska Native children

• Explore the relationship between traditional marine diet and maternal vitamin D levels

• Discuss current education and outreach efforts
Vitamin D deficiency

- Nutritional deficiency
- Increasing in prevalence
- Risk factors—insufficient dietary intake and sun exposure:
  - Darker skin color
  - Use of sunscreen
  - Limited intake of foods high in Vitamin D
  - Northern latitudes (above 37 degrees latitude)
  - Breastfeeding without Vitamin D supplementation

Rickets

- Failure of mineralization of growing bone and cartilage
- A state of extreme vitamin D deficiency
- Peak incidence between 3 and 18 months of age

Definition of Vitamin D Deficiency

2014 AAP Guidelines (Ped 2014;134:e1229)
- Vitamin D deficiency is 25OHD below 20ng/ml
  - Also Institute of Medicine (2010), Pediatric Endocrine Society, and the European Society for Paediatric Gastroenterology, Hepatology, and Nutrition

2011 Endocrine Society Clinical Practice Guidelines (JCEM 2011;96(7):1911)
- Vitamin D deficiency is 25OHD below 20 ng/ml;
- Vitamin D insufficiency is 25OHD 21-29 ng/ml
Screening for Vitamin D Deficiency

• Evidence is insufficient to recommend universal screening for vitamin D deficiency

• AAP advises screening for vitamin D deficiency only in children and adolescents with conditions associated with reduced bone mass and/or recurrent low impact fractures
  • Endocrine society: screen “at-risk individuals,” including children with obesity, black and Hispanic children, malabsorption syndrome, and medications that alter vitamin D
  • Controversial because would involve screening, treating, and retesting large numbers of children without good evidence of cost-benefit in reducing fracture risk

• Test with 25-hydroxyvitamin D (25-OH-D)

Ped 2014;134:e1229. JCEM 2011;96(7):1911
Calcium and Vitamin D content of some traditional foods

- Chum Salmon, canned with bone (3 oz)
  - 212mg Calcium
  - 328 IU Vit D
- Sockeye Salmon, canned (3 oz)
  - 197 mg Calcium
  - 715 IU Vit D
- King Salmon, with skin, kippered (3 oz)
  - 39mg Calcium
  - 44 IU Vit D
- Muktuk (3.5 oz)
  - 5mg Calcium
  - ? Vit D
- Beluga Whale Oil
  - 51 IU Vit D
- Seal Flesh (100g)
  - 5mg Calcium
- Seal Oil (100g)
  - 1mg Calcium
  - 30 IU Vit D
- Caribou (3 oz)
  - 19mg Calcium


Salmon has one of the highest vitamin D contents of any food.
Vitamin D Supplementation

• American Academy of Pediatrics Guidelines:
  • Any breastfed or partially breastfed infant: supplement with 400 IU Vitamin D.
  • Non-breastfed infants who take <1 L/day of vitamin D fortified milk/formula: supplement with 400 IU Vit D (the amount found in 1 L infant formulas).
  • Infant consuming >1 L per day fortified infant formula or weaned to vitamin-D fortified milk: no supplementation.
  • Older children and adolescents: supplementation with 600 IU Vit D is warranted if dietary intake is inadequate.

Study: Rickets and Vitamin D Deficiency in Alaska Native Children

**Background and Methods:**
- Increasing reports of vitamin D deficiency and rickets in Alaska Native children led ANTHC providers to conduct an epidemiologic study with two components:
  - Data analysis of rickets hospitalizations in Alaska Native children and US child population
  - Case control study of Alaska Native children with rickets/vitamin D deficiency and matched controls

**Investigators:**
- Rachel Lescher MD
- Rosalyn Singleton MD
- Robert Holman MS
- Bradford Gessner MD
- Timothy Thomas MD
- Thomas Hennessy MD
- Matthew Benson MD
- John Rosenfeld
- Dana Haberling
- Lisa Bulkow MS
- Anthony Kretz
- Gail Thompson RN
- James Tiesinga MD
- Michael Bruce MD

**Institutions:**
- Alaska Native Tribal Health Consortium
- Arctic Investigations Program – CDC
Study Results: Rickets Incidence by Latitude, Alaska Native children <10 years, 1999-2010
Study Results: Rickets and Vitamin D Deficiency in Alaska Native children

• Rickets inpatient and outpatient visits were more common in Alaska Native children than in the US or other IHS sites

• Rickets diagnosis increased with:
  • Increasing latitude
  • Diagnosis of malnutrition

• Rickets and vitamin D deficiency occurred in both breastfed and formula fed infants

• Rickets and vitamin D deficiency were more common in infants who did not receive vitamin D supplementation.

Confirms importance of AAP recommended vitamin D supplementation of infants to prevent vitamin D deficiency
Serologic Survey of Biomarkers for Traditional Marine Diet and Vitamin D Levels in YK Delta Childbearing-aged Women

- **Objective:**
  Explore how intake of traditional marine foods and serum Vitamin D levels have changed from 1960’s through the present

- **Method:**
  - Test representative Alaska Area Specimen Bank serum samples of YK Delta women 20-29 years old at points in time from 1960s to 1990s, for biomarkers of traditional marine diet ($\delta^{15}$N) and 25-OH vitamin D levels

- Diane O’Brien PhD, University of Fairbanks, Center for Alaska Native Health Research (CANHR)
- Rosalyn Singleton MD, ANTHC
- Ken Thummel PhD, U Wash, Pharmacy, CANHR
- Bert Boyer PhD, U of Fairbanks, CANHR
- Lisa Bulkow MS, AIP-CDC
- Joseph Klejka MD, YKHC
A Biomarker of Traditional Marine Food Intake – $\delta^{15}$N

- Fish and marine mammals are naturally enriched in the heavy stable isotope of nitrogen

- As fish and marine mammal intake increases, so does the nitrogen isotope ratio ($\delta^{15}$N) in blood and hair

- A person with no marine diet intake would have a $\delta^{15}$N of ~8 ‰

- Each increase of 1‰ (unit of relative enrichment) corresponds to an increase in traditional food intake of ~ 7% of total energy

Validated by Diane O’Brien’s group at UAF (CANHR)
Serum Vitamin D and δ^{15}N values, YK Women, 1960s to 1990s

Significant decline in both Vitamin D and δ^{15}N levels from 1960s to 1990s
Serum Vitamin D and $\delta^{15}N$ values

Correlation of Vit D and Delta 15N (log scale) - Pearson correlation 0.596 (p<0.001)
Summary: Vitamin D and δ\(^{15}\)N

- Vitamin D levels and intake of traditional marine foods decreased in YK child-bearing aged women during 1960-1990s.

- Vitamin D levels highly correlated with traditional marine food intake.

- Marine dietary intake by women of child-bearing age was very high in the 1960’s – similar to that of current Yup’ik elders - but has dropped to low levels.

- Decreased marine food intake and vitamin D levels in pregnant women could put their infants at risk for vitamin D deficiency/rickets.
Next Steps

• What ANTHC, YKHC and DPH have done
  • **State Epi Bulletin** on Rickets and vitamin D deficiency in children
  • Anchorage and Bethel **Grand Rounds** presentations to providers
  • Peer-reviewed **article** in *J. Pediatric Endocrine & Metabolism*
  • **Presentation** at Alaska Native Research Conference, 2014
  • **Presentation** at International Meeting on Indigenous Child Health

• What these partners are planning
  • Public relations outreach by tribal organizations and state agencies
    • **Message**: Nutritional benefit of salmon, importance of recommended vitamin D supplementation for infants and pregnant women
    • **Venues**: Mukluk, tribal presentations, etc.
  • ANTHCs “Store Outside Your Door” engaging communities to increase subsistence diet.