



# **RICKETS AND VITAMIN D DEFICIENCY IN ALASKA NATIVE CHILDREN**

Arctic Health Science Seminar March 27, 2015

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# 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)

# 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 (3oz)
  - 39mg Calcium
  - 44 IU Vit D
- Muktuk (3.5oz)
  - 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 (3oz)
  - 19mg Calcium

Nutrient Values of Alaska Native Foods, Nobmann E, Alaska Area Native Health Service, Revised December 11, 1992; October 1993.

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

## Institutions:

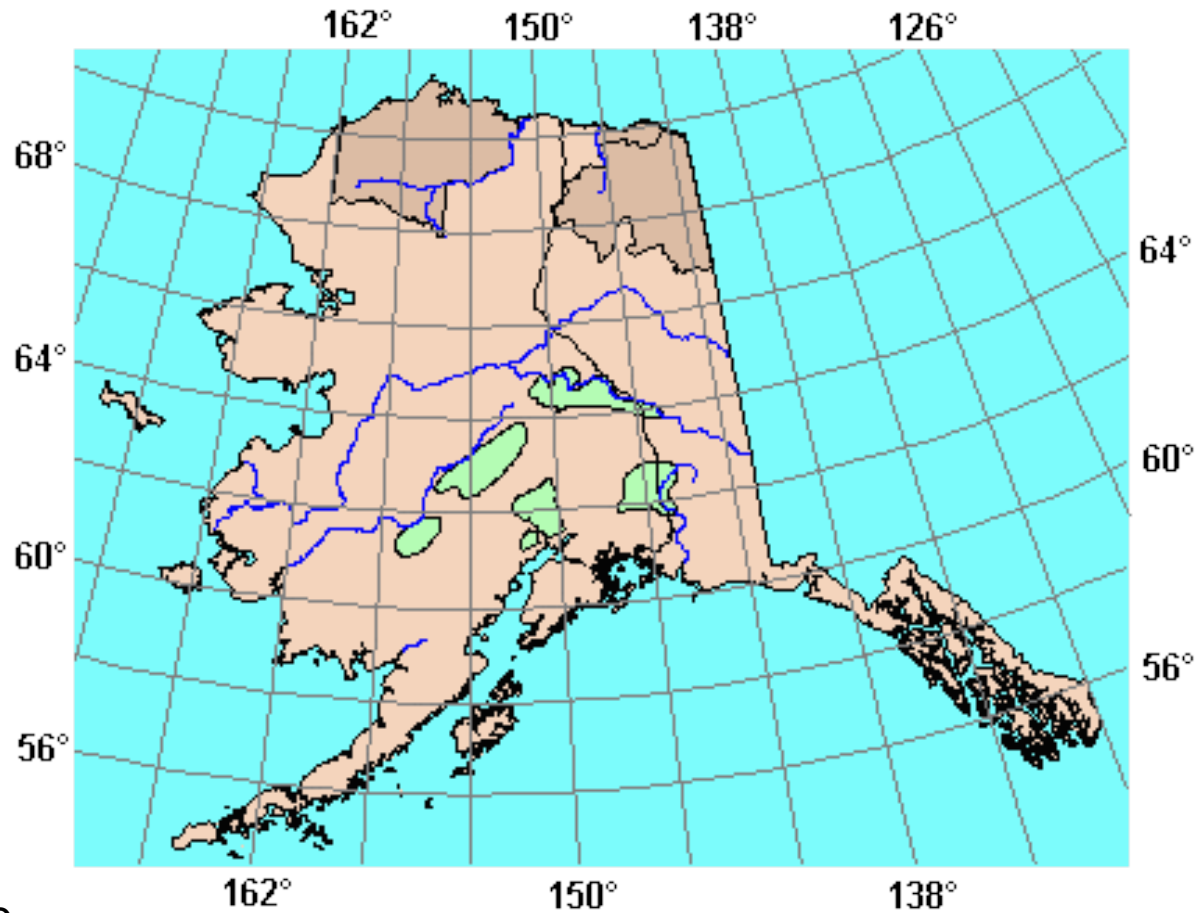
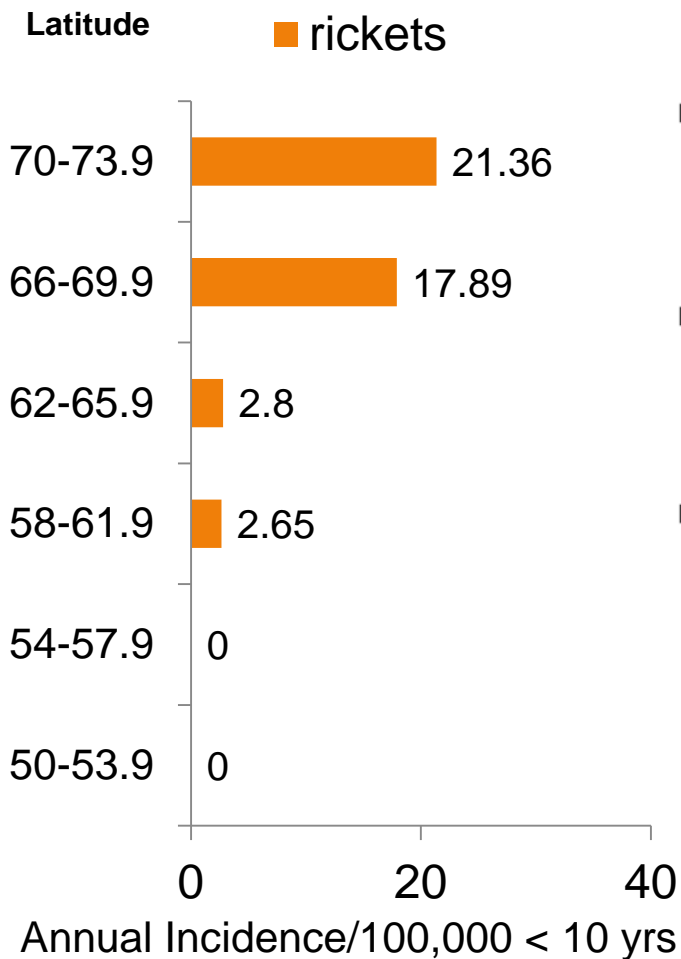
- Alaska Native Tribal Health Consortium
- Arctic Investigations Program – CDC

## Investigators:

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- Bradford Gessner MD
- Timothy Thomas MD
- Thomas Hennessy MD
- Matthew Benson MD
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- Lisa Bulkow MS
- Anthony Kretz
- Gail Thompson RN
- James Tiesinga MD
- Michael Bruce MD



# 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 ( $\delta^{15}\text{N}$ ) 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

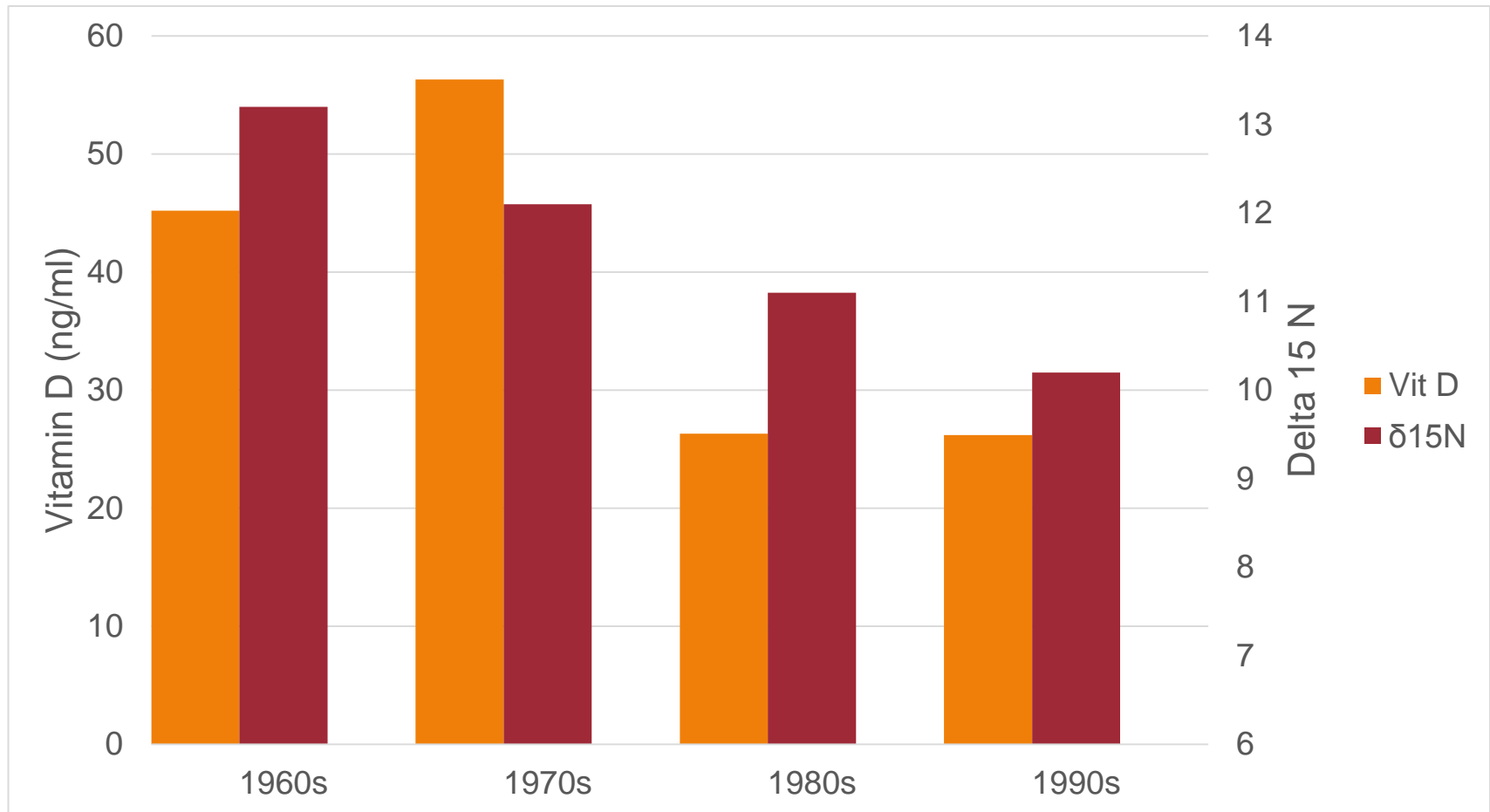
# A Biomarker of Traditional Marine Food Intake – $\delta^{15}\text{N}$

- 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 ( $\delta^{15}\text{N}$ ) in blood and hair
- A person with no marine diet intake would have a  $\delta^{15}\text{N}$  of  $\sim 8$  ‰
- Each increase of 1‰ (unit of relative enrichment) corresponds to an increase in traditional food intake of  $\sim 7\%$  of total energy



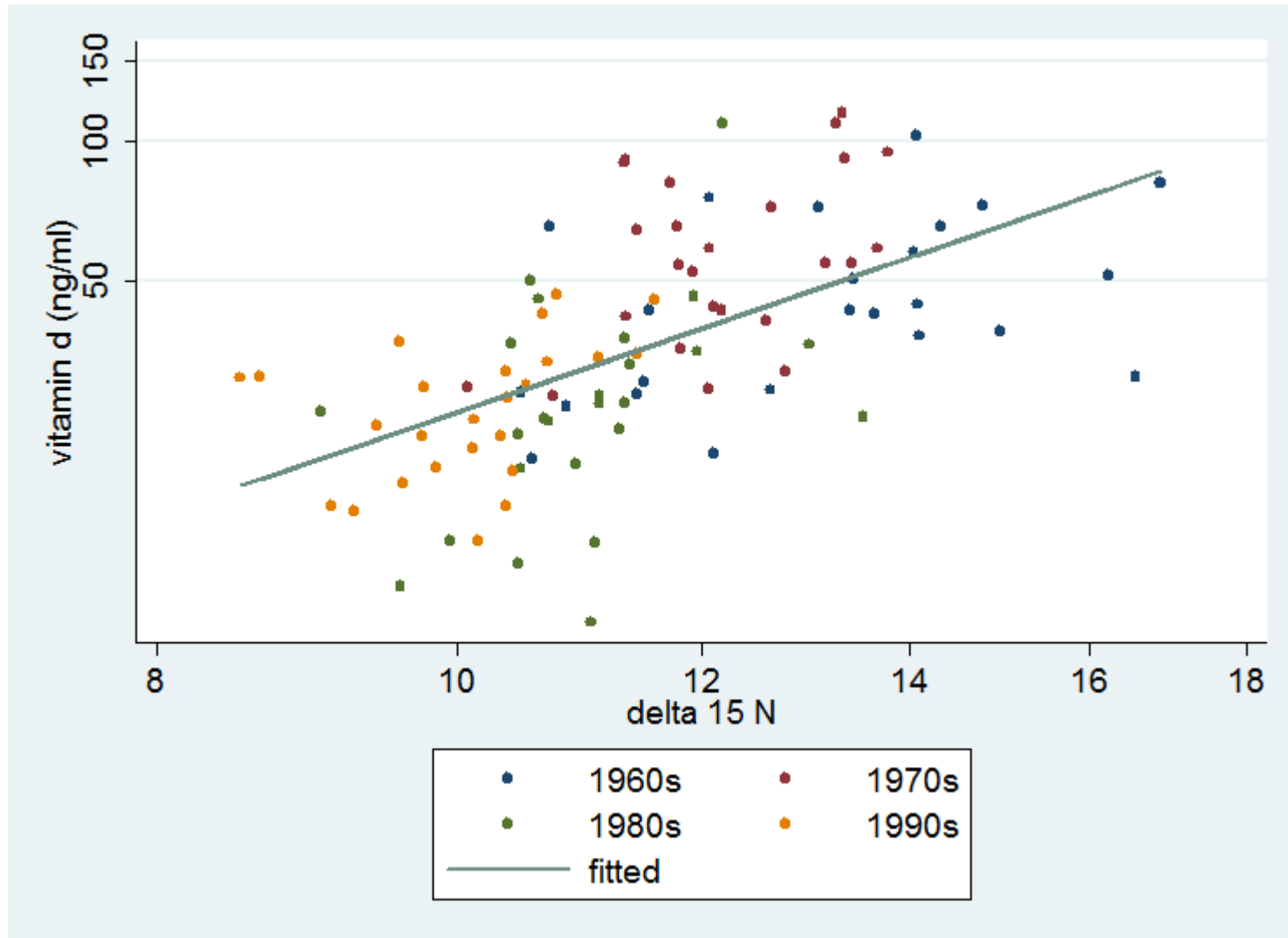
Validated by Diane O'Brien's group at UAF (CANHR)

# Serum Vitamin D and $\delta^{15}\text{N}$ values, YK Women, 1960s to 1990s



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

# Serum Vitamin D and $\delta^{15}\text{N}$ values



Correlation of Vit D and Delta 15N (log scale) - Pearson correlation 0.596 ( $p < 0.001$ )

# Summary: Vitamin D and $\delta^{15}\text{N}$

- 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.