State of Alaska Epidemiology Bulletin

Department of Health and Social Services
William J. Streur, Commissioner
Ward B. Hurlburt, MD, MPH, CMO
3601 C Street, Suite 540
Anchorage, Alaska 99503 http://www.epi.Alaska.gov

Division of Public Health
Kerre Shelton, Director
Local (907) 269-8000
24 Hour Emergency (800) 478-0084

Editors:
Joe McLaughlin, MD, MPH
Louisa Castrodale, DVM, MPH

Bulletin No. 6 May 20, 2014

Vitamin D Deficiency and Rickets among Alaska Native Children

Background

Vitamin D comprises a group of fat-soluble secosteroids that are primarily responsible for maintaining normal serum concentrations of calcium and phosphate by increasing their absorption in the small intestine. Vitamin D deficiency leads to demineralization of bones and other tissues. Risk factors for vitamin D deficiency include living in northern latitudes, having darker pigmented skin, and being an exclusively breastfed infant.[1,2] Severe vitamin D deficiency in children can lead to bone deformities known as rickets. Likely due to reduced sun exposure and inadequate dietary vitamin D intake, the incidence of rickets appears to be increasing in developed countries and in Alaska.[1,3] The purpose of this study was to better understand the epidemiology of vitamin D deficiency and rickets among Alaska Native (AN) children.

Methods

We reviewed rickets and vitamin D deficiency cases among AN children aged <10 years. We calculated the incidence of rickets-associated visits (ICD-9-CM codes 268.0–.1) during 2001–2010 among children aged <10 years who were 1) AN, 2) American Indian/Alaska Native (AI/AN) from other Indian Health Service (IHS) regions, and 3) the general U.S. population. Cases were identified and rates calculated using the IHS Direct and Contract Inpatient and Outpatient Visit Database (IHSD) for AI/AN children,[4] and the Nationwide Inpatient Sample database for U.S. general child population.[5]

We also performed a case-control study to determine risk factors for vitamin D deficiency and rickets among AN children aged <10 years for cases identified from IHSD during 1999–2012, and from chart reviews. Nutritional vitamin D deficiency was defined as having a 25-OH-vitamin D level <15 ng/mL without rickets.[6] A nutritional rickets case was defined as clinical evidence of rickets confirmed by a pediatric endocrinologist. For each case, we identified and conducted chart reviews on 2–5 AN control participants, matched on birthdate and region.

Results

Rickets Rate Comparisons, United States and Alaska

During 2001–2010, the average annual inpatient and outpatient incidence of rickets among children aged <10 years was higher in AN children than in AI/AN children living in other IHS regions (Table 1). The inpatient incidence of rickets was also higher among AN children than for the general U.S. pediatric population (Table 1).

Table 1. Average Annual Rate of Rickets in Children Aged <10 Years — United States and Alaska, 2001–2010

Children Aged <10 Years	Inpatient	Outpatient
	Rate per 100,000	Rate per 100,000
General U.S.	1.2 (95% CI 1.1–1.4)	N/A
Non-Alaska AI/AN	0.1	3.1
Alaska Native	2.2	11.2

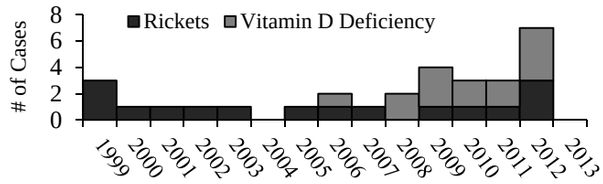
Rickets and Vitamin D Deficiency Cases in Alaska

During 1999–2012, 30 cases of nutritional rickets (n=16) and vitamin D deficiency (n=14) were identified among AN children aged <10 years (Figure); 18/30 (60%) were male. The mean age of diagnosis among rickets cases was younger than among children who had vitamin D deficiency without rickets (1.0 year vs. 4.0 years, respectively; p<0.01).

Children with rickets presented with the following clinical signs: 7/10 children who were diagnosed in their first 12 months of life presented with hypocalcemic seizures (n=3) or failure to thrive (n=4); 6/6 children who were diagnosed after 12 months of age presented with leg bowing. Radiographic findings in rickets patients included rachitic rosary, fractures, metaphyseal changes (in infants), and metaphyseal changes and leg bowing (in children aged >12 months).

During 1999–2013, the statewide average annual incidence of rickets among AN children aged <10 years was 4.2 per 100,000 persons. When examined by latitude of Alaska residence (between 50º and 73º), the incidence of rickets in this cohort of children increased 2.3 fold for every 4º increase in latitude (range 0–21.4 cases per 100,000 persons; p<0.001).

Figure. Cases of Rickets and Vitamin D Deficiency among AI/AN Children Aged <10 Years — Alaska, 1999–2012



Case-Control Study

Rickets and vitamin D deficiency cases were more likely than controls to have been diagnosed with malnutrition, and less likely than controls to have received vitamin D supplementation in the first 6 months of life (Table 2).

Table 2. Comparison of Rickets or Vitamin D Deficiency Cases with Matched Controls — Alaska, 1999–2013

	Cases N=26 (%)	Controls N=93 (%)	Matched OR (p-value)
Male sex	14 (54)	39 (42)	1.7 (0.25)
Malnutrition	12 (47)	2 (2)	**38.1 (0.001)**
Exclusively formula-fed	2/20 (10)	13/79 (16)	0.31 (0.28)
Ever solely breast fed	10/15 (67)	39/75 (52)	2.1 (0.29)
Vitamin D Supplement*	3/18 (17)	32/67 (48)	**0.2 (0.03)**

***Vitamin D supplementation at some point during the first 6 months of life among infants diagnosed with rickets at ≥6 months of age.*

Discussion

Rickets was more common in AN children than in other U.S. children, and the incidence of rickets increased with increasing geographic latitude within Alaska. Providers should be aware that vitamin D deficiency remains a concern for children living in Alaska. This study highlights the importance of recognizing the following pediatric risk factors for rickets in Alaska: general malnutrition, darker pigmentation, living at higher latitude, and lack of vitamin D supplementation in breastfed and formula fed infants. Health care providers should consider vitamin D screening of high-risk children and those with signs or symptoms of rickets. All infants taking <1L of formula should receive 400 IU of vitamin D daily.[2]

References

1. Thacher T et al. Nutritional rickets around the world: causes and future directions. *Ann Trop Pediatr* 2006;26:1-16.
2. Wagner C, Greer F, AAP. Prevention of rickets and vit. D deficiency in infants, children and adolescents. *Pediatrics* 2008;122:1142-1152.
3. Gessner BD, et al. Nutritional rickets among breast-fed black and Alaska Native children. *Alaska Med* 1997;39:72-74
4. Indian Health Service. Direct/CHS Inpatient and outpatient visit data, fiscal years 2001-2011. Albuquerque, NM: Indian Health Service; 2012.
5. Healthcare Cost and Utilization Project (HCUP). AHRQ. Nationwide Inpatient Sample (NIS. http://www.hcup-us.ahrq.gov/nisoverview.jsp)
6. Misra M, et al. Vitamin D Deficiency in Children and Its Management. Review of Current Knowledge and Recs. *Pediatrics*. 2008; 122:398-417.

(Contributed by: Rosalyn Singleton MD, ANTHC, Rachel Lescher MD, ANTHC, Matthew Benson MD, ANTHC, Bradford Gessner MD, Lisa Bulkow MS, CDC-AIP, John Rosenfeld MD, ANTHC, James Tiesinga, MD, ANTHC, Michael Bruce MD, CDC-AIP)