

Nutritional Rickets in Breast-Fed Infants

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A ten-year literature review was prompted by the fortuitous discovery of nutritional rickets in a "well child." Sixty-three cases were identified, suggesting that this disease is not so rare as thought. Rickets should be considered in the differential diagnosis of nonspecific musculoskeletal complaints and poor growth. Vitamin D supplementation in breast-fed children should be prescribed more often.

Breast feeding is the preferred chief source of sustenance for a young infant. After a period of bottle popularity, breast feeding has reemerged as a positive and popular trend in American child-rearing practices. As nature's ideal infant food, breast milk is correctly assumed to be nutritionally complete for most children. The American Academy of Pediatrics' Committee on Nutrition, in its 1980 recommendations,¹ advocates only breast milk until four to six months of age and does not routinely advise vitamin or mineral supplements for the full-term breast-fed infant.¹⁻³ Recent prac-

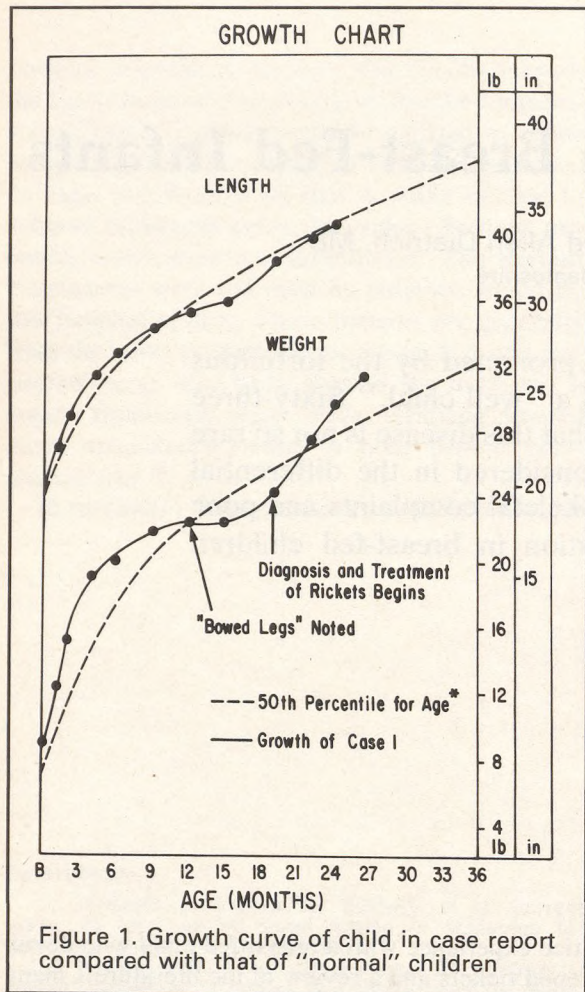
tice experience with a breast-fed child who developed rickets and a review of the literature's many case reports of vitamin D deficiencies in breast-fed children suggest a need to reevaluate supplement recommendations.

Case Report

A 19-month-old boy, born by cesarean section at 42 weeks gestation to a healthy 35-year-old black primigravid woman, was followed for well-child care at a family practice center. He had no major health problems, being seen for immunizations and routine well-child care. He was seen for infantile eczema at one month and eight months, which resolved quickly when treated with 1 percent hydrocortisone cream.

The mother ate a high-protein, high-calcium diet and took prenatal vitamins and iron during

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*Based on Hamill PVV, Drizd TA, Johnson CL, et al: Physical growth: National Center for Health Statistics percentiles. *Am J Clin Nutr* 1979; 32:607-629

both pregnancy and lactation. The infant was fed breast milk exclusively until the age of six months, when rice cereal and baby foods of all types were added. Breast milk continued to be his chief fluid source until he was weaned at 12 months. At the 12-month well-child checkup parents and physician noted that his legs were bowed and that height and weight had dropped from the 50th percentile to the 25th percentile on growth curves (Figure 1). The bowing was considered to be "physiologic."

When weaned at 12 months, the child refused to

drink cow's milk, and his parents compensated for this idiosyncrasy by substituting yogurt, cheese, and ice cream as calcium sources. They even consulted the practice's dietitian to obtain hints at providing necessary nutrients. By 16 months of age the boy was persuaded to drink one glass of milk per day.

The bowing of the legs progressed between 12 and 18 months, and the parents expressed increasing concern over this fact. At the 18-month checkup a new physician was seen who felt that the bowing was excessive (Figure 2). Radiographs were obtained, and the findings were compatible with "healing rickets." The radiologist felt that the process had begun six to eight months earlier, and new bone growth indicated a recent improvement. Calcium level was initially 9.4 mg/dL, phosphorus, 3.9 mg/dL, and alkaline phosphatase, 621 IU/L (normal range, ages 1 to 2 years, 146 to 477 IU/L).⁴ Vitamin D, 1,500 IU/d, was begun. After six weeks the child's calcium level was 9.6 mg/dL, phosphorus, 5.2 mg/dL, and alkaline phosphatase, 386 IU/L, with clinical and radiologic improvement of the bowed legs.

Careful review of this child's behavioral habits revealed that he had obtained an abundance of sunshine in the summer of his first year (between 9 and 12 months), although he lived in the suburbs of a large northeastern city. There was no family history of rickets. Growth improved after adding vitamin D to his diet, and he is doing well at 2 1/2 years of age.

Historical Perspective

Evident even in ancient times, rickets became epidemic with the urbanization of the early 19th century. In 1807 Bardsley suggested that cod liver oil be used to treat osteomalacia; and Palm, in 1890, advocated sunlight for its antirachitic action.^{5,6} The discovery that antirachitic activity could be produced in foodstuffs by ultraviolet irradiation led to the fortification of milk and the subsequent virtual elimination of rickets. A disease that was in 1940 the "most common disease of early childhood" became in 1966 "one of the rare diseases in this country and a medical curiosity in the major children's clinics."⁶

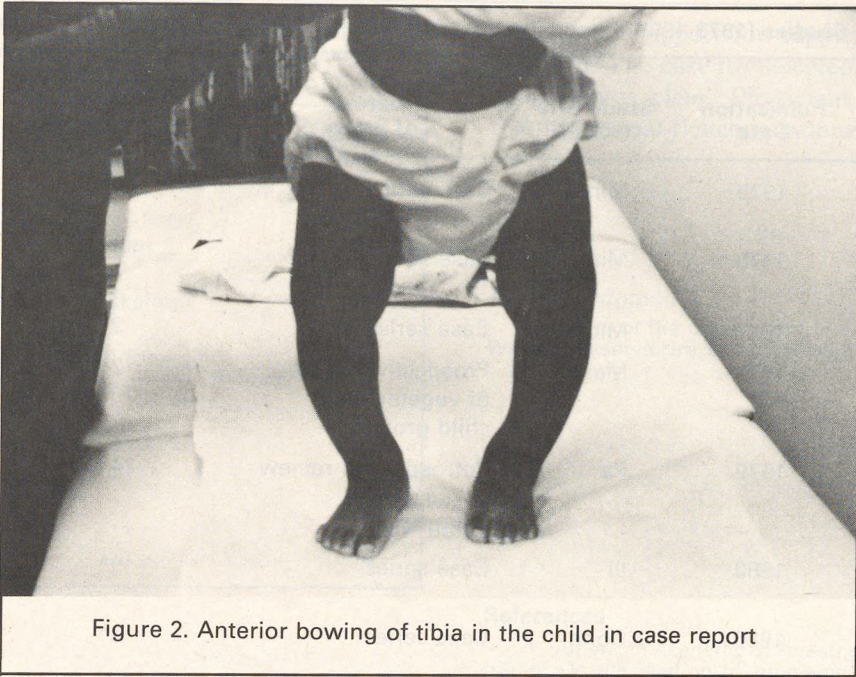


Figure 2. Anterior bowing of tibia in the child in case report

Literature Review

The fortuitous and timely discovery of nutritional rickets in a child being evaluated for bowed legs prompted a literature search for other such cases. A MEDLINE search was performed, and in the last ten years (1973 to 1983) in American literature alone, 63 cases of nutritional rickets in breast-fed infants were reported in 11 reports from various centers (Table 1).⁷⁻¹⁷

At presentation, the children were 2 to 45 months of age. Characteristics of the patients are not consistently reported, but based on data given, 31 (of 48 who had the necessary data provided) were male, 20 (of 33) were Muslim, 4 (of 33) were Seventh Day Adventists, 40 (of 44) were black, and 29 (of 41) were over six months of age and still on either breast milk alone or on a milk-free vegetarian diet. Most cases were reported by northeastern medical centers. With the exception of siblings or friends of those with diagnosed cases, almost all of these patients were identified incidentally, commonly through the evaluation of non-specific musculoskeletal stigmata (bowed legs, abnormal gait) or by means of a radiograph ob-

tained for another purpose (Table 2). Often, this radiograph was a chest x-ray film ordered to evaluate cough. Twenty-eight out of 42 children for whom data are available were in the less than third percentile for height and weight at time of presentation.

Comment

The implication of such a large number of case reports for such a seemingly rare disease is that nutritional rickets is not rare. If 63 cases were fortuitously discovered and reported, how many more were not discovered or not reported? How many cases of bowed legs, delayed development, or poor growth in childhood may be due to subclinical rickets?

As little as 100 IU of vitamin D daily will protect most infants from rickets, and 400 IU will protect all children.⁵ One quart of fortified milk contains 400 IU. Vitamin D is made through the skin following sunlight (ultraviolet radiation) exposure. Ul-

Table 1. Studies (1973-1983) Reporting Cases of Nutritional Rickets in Breast-Fed Children

Study Author	Publication Date	Study Site (state)	Nature of Study	Number of Cases Reported	Age Range at Presentation (months)
Castile et al ⁷	1975	Minn	Case series	1*	13½
Arnaud et al ⁸	1976	Minn	Case series	7*	2-42
O'Connor ⁹	1977	Mich	Case series	2	4½, 16
Dwyer et al ¹⁰	1979	Mass	Prospective study of vegetarian child growth	2*	27, 33
Bachrach et al ¹¹	1979	Pa	Retrospective review of hospital diagnoses	24	4-45
Edidin et al ¹²	1980	Ill	Case series	9*	7-20
Rudolf et al ¹³	1980	Conn	Case series	3*	17-18
Warrier et al ¹⁴	1981	Mich	Case series	2	14, 28
Little ¹⁵	1982	La	Retrospective review of medical center diagnoses	6	5-20
Baron and Phiripes ¹⁶	1983	Calif	Case report	1	9
Lumpkins and Oestreich ¹⁷	1983	Ohio	Case series*	1	3-30

*Other rickets cases reported, but either children were not breast-fed or insufficient data are provided to draw a firm conclusion. In all, 63 cases were reported in these studies

traviolet light between 240 and 315 mμ will prevent rickets. No study as to duration of sun exposure necessary to protect a child has been done.

The American Academy of Pediatrics' Committee on Nutrition (1979-1980) states that "rickets is rarely seen in breast-fed infants" and that only "when climatic and social conditions interfere with radiation of vitamin D precursors in the skin, breast-fed infants should be supplemented with 400 IU of vitamin D daily."^{1,2} Perhaps this statement is too vague, for most of the children in these case reports were exposed to sunlight and had

only dark skin as a risk factor. Perhaps all black children should routinely receive vitamin D. Vitamin D is available in a liquid solution containing 8,000 IU/mL (Drisdol, Wyeth Laboratories). At a cost of \$20.30 per 2-oz bottle (local pharmacy price), the cost of supplementing infants with 400 IU of vitamin D per day is \$0.017, or \$6.18 per year. Although no statistics are available for the national cost of rickets (x-ray studies, remedial teaching, slow development), one would guess that a cost-benefit analysis would favor supplementation.

Table 2. Presenting Problems of Breast-Fed Infants Subsequently Diagnosed as Having Nutritional Rickets

Presenting Problem	Number (n=63)
Incidental finding on radiograph or physical examination	19
Nonspecific musculoskeletal complaints	16
Failure to thrive/small for age	5
Delayed development	6
Seizures	5
Sibling with rickets	4
Tetany	2
Weakness	1
Drowsiness	1
Not specified	4

Conclusions

That children who are carefully followed for well-child care develop unsuspected nutritional rickets indicates that physicians need to raise their level of suspicion for this disease. By following current standards, physicians may become complacent and refrain from supplementation when it is needed. Only after a careful and specific dietary history can one safely assume breast milk to be nutritionally complete for a child. This statement contradicts the reassuring statements of LaLeche League publications and popular lay texts¹⁸ on breast feeding, which assure their readers that breast milk is always best and complete.

Physicians should consider the administration of vitamin D supplements to infants with any of the following characteristics:

1. Dark skin and residence in the northeastern United States
2. Exclusive breast feeding for longer than six months
3. Restrictive diets, such as true vegans
4. Avoidance of sun or draping of the body

These factors have been identified before, but

widespread support for supplementation has not followed. The case for selected vitamin D supplementation is clear. Physicians should recognize that nutritional rickets continues to occur.

Acknowledgment

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