

Resurgence of Nutritional Rickets Associated with Breast-Feeding and Special Dietary Practices

Deborah V. Edidin, MD, Lynne L. Levitsky, MD, William Schey, MD, Nives Dumbovic, MD, and Alfonso Campos, MD

From the Department of Pediatrics, Division of Endocrinology and Metabolism, and the Department of Diagnostic Radiology, Pediatric Division, Michael Reese Hospital and Medical Center, Pritzker School of Medicine, University of Chicago

ABSTRACT. Ten cases of nutritional rickets seen over a 10-month period are reviewed. The salient clinical features are summarized, and the striking association with unsupplemented breast-feeding, fad diets, and lack of immunizations is discussed. The importance of recognizing such associated practices for purposes of early diagnosis and intervention is stressed. *Pediatrics* 65:232-235, 1980; *breast feeding, nutritional rickets, vitamin D deficiency, fad diets.*

Rickets is a disorder recognized since antiquity.¹ The role of sunlight and vitamin D in the treatment of this disease was demonstrated in the early part of this century. The introduction of calciferol-fortified products has been so successful that, in 1966, Harrison² referred to nutritional rickets in the United States as a "medical curiosity" in the major children's clinics. Recently, the Committee on Nutrition of the American Academy of Pediatrics has published two reviews which bear on the issue of breast-feeding.^{3,4} Neither article addresses the potential hazard of unsupplemented breast-feeding. We believe, therefore, that it is important to report our current experience with nutritional rickets and to describe the association of prolonged, unsupplemented breast-feeding and vegan diets with this disorder.

Over a ten-month period, we have seen ten cases of nutritional rickets. Table 1 illustrates the salient

features of each case. Table 2 summarizes the frequency of occurrence of specific clinical findings in these rachitic children.

Two case reports are described in detail. They were selected because they illustrated many of the historic and clinical features which typified our other eight patients. In addition, they provide family profiles not evident from the Tables; the significance of these profiles is discussed.

CASE REPORTS

Case 1

Patient S.C., a 20-month-old black male, presented to the emergency room with progressive swelling and tenderness over the left thigh following a fall from a bed one week prior to presentation. Radiographs revealed a nondisplaced proximal femoral fracture. The patient's mother refused treatment and took the child to a "nature healer." Police retrieved the child on a court order, and the leg was placed in a cast. Follow-up films of the left femur revealed progressive healing; however, comparison films of the opposite femur demonstrated a healing fracture distally. The question of child abuse was raised. A skeletal survey revealed diffuse osteoporosis with a trabecular pattern in multiple vertebral bodies, and epiphyseal plate changes including widening and fraying. The patient was admitted for a medical evaluation.

He was born to a gravida 4, para 1 mother with no prenatal care. Birth weight was 3,920 gm. He was breast-fed for nine months, without vitamin D supplementation, after which he received only home-prepared unsupplemented soy milk, fruits, and vegetables until the time of admission. The parents were also strict vegetarians.

On physical examination, the child was an active toddler with prominent bowing of the legs, a rachitic rosary, and flaring of both wrists and ankles. His weight was 11.5 kg (25th percentile); height was 79 cm (3rd percentile). The hemoglobin was 10.9 gm/100 ml, and the hematocrit

Received for publication Dec 18, 1978; accepted June 11, 1979.
Reprint requests to (L.L.L.) Department of Pediatrics, Michael Reese Hospital and Medical Center, 29th St and Ellis Ave, Chicago, IL 60616.
PEDIATRICS (ISSN 0031 4005). Copyright © 1980 by the American Academy of Pediatrics.

TABLE 1. Case Profiles*

Patient	Season of Diagnosis	Age at Diagnosis (mo)	Breast-Fed Exclusively (mo), No Vitamins	Presenting Problem	Special Dietary Patterns	Primary Care and Dietary Advice	Physical Findings	Percentile Ht/Wt	Immunizations	Hb (gm/100 ml)/Hct (%)	Calcium (mg/100 ml)/Phosphorus (mg/100 ml)	Alkaline Phosphatase (units)
Z.H.	Early spring	14	9	Weak, delayed walking	Strict vegetarian; fruit, vegetables, soy milk at 9 mo	No primary care	Frontal bossing, rachitic rosary	<3/<3	Refused—personal beliefs	11.2/35	4.6/1.9	22.4 (N, 4-8)
S.C.	Early spring	20	9	Delayed walking, painful hip after fall	Strict vegetarian; soy milk after 9 mo	Naprapath; health food store	Fracture left femur, flaring of wrists and ankles, Harrison's grooves, mild bowing	<3/25	Refused—personal beliefs	10.9/33	9.6/3.2	21.8 (N, 4-8)
S.A.	Winter	7	7	Tachypnea, URI, slow development	Strict vegetarian	No primary care; dietary advice from health food store	Bowed legs, rachitic rosary	<3/<3	Refused—personal beliefs	11.1/37.5	10.2/2.5	1,736 (N, 100)
J.P.	Winter	4	0	Seizures	Dietary manipulation with ½ strength formula	Dietary manipulation by primary care physician for vomiting and diarrhea	Rachitic rosary	<3/<3	None—always ill when immunizations due	9.7/29.6	7.4/3.3	793 (N, 100)
N.A.	Winter	16	14	Fever, URI	Strict vegetarian; supplementation with food and vitamins at 14 mo	No primary care; dietary advice from health food store	Flaring, rachitic rosary, pot-bellied, pale, bossing	3/3	None—personal beliefs	12.7/35.9	9.5/4.1	962 (N, 100)
A.H.	Early spring	7	7	Wheezing, URI	Fruit supplementation only	Receiving primary care; dietary advice from health food store	Normal	<3/10	Up to date	12.9/37.4	10.2/2.9	1,096 (N, 100)
T.R.	Summer	11	8	Car accident followed by limp	Table food after 8 mo	Receiving primary care	Leg tenderness	3/25	Up to date	8.5/27.5	9.1/2.5	266 (N, 100)
A.C.	Early spring	14	9	Refusal to bear weight	Strict vegetarian	No primary care	Rachitic rosary, bowed legs, bossing, flared wrists	<3/<3	None	11.5/33	5.3/2.1	260 (N, 100)
S.S.	Winter	14	8	URI, poor growth	Strict vegetarian; almond paste milk, cereal, potatoes, rice, beans	No primary care	Dehydration, pneumonia, rosary, flaring Harrison's grooves	<3/<3	Refused—personal beliefs	9.2/27.3	8.5/0.8	204 (N, 100)
T.H.	Summer	9	7	URI	Varied after 7 mo	No primary care	Large fontanelle, flaring	<3/<3	None	—	7.9/2.7	233 (N, 100)

*Abbreviations used are: URI, upper respiratory infection; N, normal.

TABLE 2. Frequency of Occurrence of Clinical Findings

Important Clinical Features	No. of Patients/ Total Patients
1. Presentation in winter or early spring	8/10
2. Breast-fed infants with inadequate D supplementation	9/10
3. Dietary manipulation by physician for diarrhea	1/10
4. Fad diets	6/10
5. Clinical evidence of rickets on physical examination	8/10
Rachitic rosary	5/8
Bowing of lower extremities	3/8
Widening of wrists and ankles	5/8
Frontal bossing	3/8
Harrison's groove	2/8
6. Delayed developmental milestones	7/10
7. ≤ 3 rd percentile in length	10/10
8. No immunizations	8/10
On basis of religious or personal beliefs	5/8
9. Acute care only	7/10
10. Lower or lower-middle socioeconomic class	10/10
11. Significant upper or lower respiratory infections at presentation	5/10
12. Hypochromic, microcytic anemia	8/9
13. Presenting calcium ≤ 9.5 mg/100 ml	7/10
14. Presenting phosphorus ≤ 4 mg/100 ml	9/10*
15. Under 6 mo of age at presentation	1/10
6–12 mo	4/10
Over 1 yr	5/10

*One patient had begun receiving vitamin therapy prior to presentation.

was 33%. The mean corpuscular volume (MCV) was 90 cu μ m, mean corpuscular hemoglobin (MCHb), 29.7 pg, and mean corpuscular hemoglobin concentration (MCHC), 32.8%. Urinalysis was normal as were serum electrolytes and pH. Serum calcium was 9.6 mg/100 ml, phosphorus 3.2 mg/100 ml, and alkaline phosphatase 21.8 Bodansky units (normal 4 to 8). Vitamin D, 10,000 IU per os daily, was initiated, and radiographic evidence of healing was present two weeks later.

Case 2

Patient N.A., a 16-month-old black female, lived with her parents and siblings. She had been well until two days prior to admission when she was brought to the emergency room because of fever and coryza. She was admitted because of her small, rachitic appearance.

Her prenatal history was unremarkable. The mother was a strict vegetarian. The mother also wore copious garments which covered all parts of her body except face and hands. The child had been entirely breast-fed since birth until two months prior to admission. She received no vitamin supplementation. The family, which was Muslim, had been receiving dietary advice from a neighborhood health food store. At 14 months of age, because of

poor growth and delayed milestones over the last four to six months, the child was brought to a pediatrician who recommended the addition of vegetables, eggs, fruit, and cheese to the diet, as well as supplemental vitamins with iron.

The patient was irritable, pot-bellied, and pale. Her length was 73.5 cm, and her weight was 6.95 kg. Frontal bossing, rachitic rosary, flared wrists and ankles, and bowing of the lower extremities were evident. Her laboratory findings included a chest x-ray compatible with rickets, Hb, 12.7 gm/100 ml, Hct, 35.9%, MCV, 75 cu μ , MCH, 26 pg, MCHC, 34.4%. Urinalysis, serum electrolytes, and pH were normal. Serum calcium was 9.5 mg/100 ml, phosphorus 4.1 mg/100 ml, total protein 6.4 gm/100 ml, albumin 4.8 gm/100 ml, globulin 1.6 gm/100 ml, and alkaline phosphatase 962 normalized units/100 ml (normal for adults, 25 to 100 units/100 ml). Her developmental quotient was 95, with lowest scores in motor and language areas and normal personal-social behavior. The patient was begun on oral calciferol, 5,000 IU daily, and discharged several days later. The parents agreed to immunizations. They referred another Muslim child (patient S.A. in Table 1) who had received dietary advice at the same health food store to this medical center because of similar problems.

DISCUSSION

"Nutritional rickets" is a disease caused by inadequate exposure to sunlight. Dietary vitamin D is essential only when there is poor exposure of the skin to ultraviolet irradiation, resulting in diminished calcium absorption so that hypocalcemia, with or without tetany, hyperparathyroidism, hypophosphatemia, aminoaciduria, and skeletal changes appear.⁵⁻¹⁰ Although it has been suggested that breast milk contains sufficient vitamin D when assayed properly,¹¹ most authorities believe that it provides as little as 10 IU of vitamin D per day in the winter and 20 IU/day in summer.¹² Infants receiving breast milk alone may have low circulating levels of vitamin D and a much increased incidence of rickets when not exposed to the sun.¹⁷

In 1962, the American Academy of Pediatrics published a survey of infantile scurvy and nutritional rickets in the United States as seen in 294 hospitals with approved pediatric residency programs.¹⁴ Between 1956 and 1960, 843 cases of nutritional rickets were admitted, and an incidence of 1:2,791 was reported. In 1916, most urban babies were still breast-fed at 1 year of age. In 1966, 27% were breast-fed, and the mean duration of breast-feeding was 3½ months. This decade has seen a major increase in the incidence and duration of breast-feeding which has been noted primarily in higher socioeconomic brackets but appears to be affecting other socioeconomic groups as well. As a result of this trend, there have been several recent reports of nutritional rickets in breast-fed infants whose his-

tories and clinical features resembled our patient series.¹⁵⁻¹⁷ In addition, current authorities have endorsed vitamin supplementation of the breast-fed infant.¹⁸

Despite such attempts to remind physicians that rickets still occurs in unsupplemented breast-fed infants, the American Academy of Pediatrics' 1977 statement addressing itself to changing nutritional trends and high-risk dietary patterns makes no clear statement about vitamin supplementation of the breast-fed infant. Even more recently, the Nutritional Committee of the Canadian Paediatric Society and the Committee on Nutrition of the American Academy of Pediatrics reviewed key issues in breast-feeding and endorsed breast-feeding without advising vitamin supplementation.

The patients we report share with each other those features commonly seen in patients with nutritional rickets; all cases were associated with low calciferol intake due to unsupplemented breast-feeding, dietary manipulation, or fad diets. Patients and their mothers had minimal exposure to sunlight because of protective clothing or unsafe neighborhood conditions prohibiting outdoor activities. Many of our patients developed rickets while receiving only unsupplemented breast milk, while others were diagnosed a few months after other calciferol-poor foods were added to the diet. The reasons for practicing special diets include poverty, religious beliefs, and misguidance. All children fed vegan diets had also received unsupplemented breast milk. Oral calciferol, 5,000 to 10,000 IU/day reversed the biochemical, radiologic, and clinical findings characteristic of rickets in our patient series. These children's parents were deeply concerned about their children's health and nutrition; however, nutritional counseling did not come from conventional sources. The children received acute medical care only.

The acute facility is often suboptimal for detecting early nutritional problems, since the history is usually focused on the present illness. In addition, these facilities are often staffed by younger physicians who were not practicing in an era when vitamin deficiency and rickets were more prevalent. They have had less need to master the field of nutrition since foods are enriched, fortified, and prepackaged. In addition, their current reference literature fails to reemphasize the advisability of calciferol supplementation.

It is not our desire or purpose to discourage breast-feeding. It is a clean, nutritious, natural, and inexpensive source of milk and provides the infant and mother with a unique physical and emotional

closeness. However, it is our hope that pediatricians will review the nutritional status of their patients. If a child is being breast-fed, or is on a restricted or unusual diet, questions should be asked about supplementation of that child's diet as well as the diet of siblings. A history of lack of immunizations should alert the physician to review dietary practices since many families may be amenable to counseling and revision of such practices.

ADDENDUM

After submitting this manuscript, we admitted an additional child who presented with hypocalcemic tetany. The child was 11 months old and had been receiving a diet of unsupplemented breast milk. His mother was eating a conventional diet. Historic, clinical, and radiographic features were consistent with nutritional rickets.

REFERENCES

1. Weick MT: A history of rickets in the United States. *Am J Clin Nutr* 20:1234, 1967
2. Harrison HE: A tribute to the first lady of public health. V. The disappearance of rickets. *Am J Public Health* 56:734, 1966
3. American Academy of Pediatrics, Committee on Nutrition: Nutritional aspects of vegetarianism, health foods and fad diets. *Pediatrics* 59:460, 1977
4. Nutritional Committee of the Canadian Paediatric Society and the Committee on Nutrition of the American Academy of Pediatrics: Breast-feeding. *Pediatrics* 62:591, 1978
5. Root AW, Harrison HE: Recent advances in calcium metabolism. I. Mechanisms of calcium homeostasis. *J Pediatr* 88: 1, 1976
6. Root AW, Harrison HE: Recent advances in calcium metabolism. II. Disorders of calcium homeostasis. *J Pediatr* 88: 177, 1976
7. Bergstrom WH: Calciferol deficiency here and now. *Am J Dis Child* 129:1137, 1975
8. Gupta MM, Round JM, Stamp TCB: Spontaneous cure of vitamin D deficiency in Asians during summer in Britain. *Lancet* 1:586, 1974
9. Harrison HE, Harrison HC: Rickets then and now. *J Pediatr* 87:1144, 1975
10. Loomis WF: Rickets. *Sci Am* 223:76, 1970
11. Lakdawala DR, Widdowson EM: Vitamin D in human milk. *Lancet* 1:167, 1977
12. Fourman D, Royer P: *Calcium Metabolism and the Bone*, ed 2. Philadelphia, FA Davis Co, 1968, p 113
13. Arnaud SB, Stickler GB, Haworth JC: Serum 25-hydroxy-vitamin D in infantile rickets. *Pediatrics* 57:221, 1976
14. American Academy of Pediatrics, Committee on Nutrition: Infantile scurvy and nutritional rickets in the United States. *Pediatrics* 29:646, 1962
15. Castile RG, Marks LJ, Stickler GB: Vitamin D deficiency rickets: Two cases with faulty infant feeding practices. *Am J Dis Child* 129:964, 1975
16. O'Connor P: Vitamin D-deficiency rickets in two breast-fed infants who were not receiving vitamin D supplementation. *Clin Pediatr* 16:361, 1977
17. Dwyer JT, Dietz WH Jr, Hass G, Suskind R: Risk of nutritional rickets among vegetarian children. *Am J Dis Child* 133:134, 1979
18. Fomon SJ, Strauss RG: Nutrient deficiencies in breast-fed infants. *N Engl J Med* 299:355, 1978

Resurgence of Nutritional Rickets Associated with Breast-Feeding and Special Dietary Practices

Deborah V. Edidin, Lynne L. Levitsky, William Schey, Nives Dumbovic and Alfonso Campos

Pediatrics 1980;65:232

Updated Information & Services

including high resolution figures, can be found at:
<http://pediatrics.aappublications.org/content/65/2/232>

Citations

This article has been cited by 13 HighWire-hosted articles:
<http://pediatrics.aappublications.org/content/65/2/232#related-urls>

Permissions & Licensing

Information about reproducing this article in parts (figures, tables) or in its entirety can be found online at:
<http://pediatrics.aappublications.org/site/misc/Permissions.xhtml>

Reprints

Information about ordering reprints can be found online:
<http://pediatrics.aappublications.org/site/misc/reprints.xhtml>

PEDIATRICS is the official journal of the American Academy of Pediatrics. A monthly publication, it has been published continuously since 1948. PEDIATRICS is owned, published, and trademarked by the American Academy of Pediatrics, 141 Northwest Point Boulevard, Elk Grove Village, Illinois, 60007. Copyright © 1980 by the American Academy of Pediatrics. All rights reserved. Print ISSN: 0031-4005. Online ISSN: 1098-4275.

American Academy of Pediatrics

DEDICATED TO THE HEALTH OF ALL CHILDREN™



PEDIATRICS®

OFFICIAL JOURNAL OF THE AMERICAN ACADEMY OF PEDIATRICS

Resurgence of Nutritional Rickets Associated with Breast-Feeding and Special Dietary Practices

Deborah V. Edidin, Lynne L. Levitsky, William Schey, Nives Dumbovic and Alfonso Campos

Pediatrics 1980;65;232

The online version of this article, along with updated information and services, is located on the World Wide Web at:

<http://pediatrics.aappublications.org/content/65/2/232>

PEDIATRICS is the official journal of the American Academy of Pediatrics. A monthly publication, it has been published continuously since 1948. PEDIATRICS is owned, published, and trademarked by the American Academy of Pediatrics, 141 Northwest Point Boulevard, Elk Grove Village, Illinois, 60007. Copyright © 1980 by the American Academy of Pediatrics. All rights reserved. Print ISSN: 0031-4005. Online ISSN: 1098-4275.

American Academy of Pediatrics

DEDICATED TO THE HEALTH OF ALL CHILDREN™

