# Assessment of nutritional rickets in Western Saudi Arabia

***Nadia M. Fida,*** *MBBCh, AbP.*

## ABSTRACT

**Objectives:** To explore the role of radiological examination and certain biochemical values in diagnosis and assessing severity of nutritional rickets.

**Methods:** Cases of symptomatic nutritional rickets (age range between 3-36 months) seen at King Abdul-Aziz University Hospital, Jeddah, Kingdom of Saudi Arabia, during the period 1997-1999 were studied. Clinical examination by the author of the study, determination of calcium (Ca), phosphate ($PO_4$), alkaline phosphates (ALP), hand and wrist x-rays, were performed for all cases.

**Results:** Sixty cases of nutritional rickets were diagnosed within 2 years (incidence of 0.5%), 38.3% of the patients presented with swollen wrist and 28.3% with bowleg. The bone profile at time of diagnosis: Ca = 2.33 ± 0.23, $PO_4$ = 1.47 ± 0.40 and ALP = 925 ± 418. Approximately 81.7% of the patients had normal Ca level, 18.3% had low serum PO4 level, 98.3% showed high value of ALP. X-ray studies indicated that, 58.3% of patients had active rickets, 35% had minimal changes, and 6.7% showed healed rickets. Among those having active rickets 20% had low PO4 level, 83% had normal Ca value, and 100% had high ALP. The mean value ± SD of biochemical values in this group: Ca = 2.34 ± 0.24, PO4 = 1.45 ± 0.42, ALP = 1067 ± 452. The later was significantly higher compared to other groups (P=0.004) but no significant differences were observed between mean values of other parameters.

**Conclusion:** Radiological examination and ALP remains essential to confirm clinical diagnosis of rickets and assessment of severity.

**Saudi Med J 2003; Vol. 24 (4): 337-340**

Nutritional rickets results from defective mineralization of osteoid tissue of bone. The mineralization defect affects primarily the epipheseal growth plate, although the mineralization defect is diffuse, radiological and clinical bone lesion is predominant in areas of rapid growth. The clinical and radiological spectrum of rickets varies depending on age, etiology, duration and severity of Vitamin D (Vit D) deficiency.[1] Nutritional rickets remains prevalent in tropical countries despite the fact that such countries have ample sunlight.[2-5] Recent studies suggest that deficiency of calcium (Ca), rather than Vit D is often responsible for rickets after infancy.[6] The prevalence of clinical and sub-clinical rickets in Saudi children was studied in Children's Hospital in Riyadh, Kingdom of Saudi Arabia (KSA) (on admission) during 1986 and 1987. The prevalence of clinical rickets was estimated as 1.3% (1986) and 1.4% (1987) in a year and the prevalence of sub-clinical rickets was 3.1%.[7] Awareness of this malnutrition leads to many health recommendations for the fortification of food. Administration of Vit D to infants was encouraged as an integral part of preventive and therapeutic measures for rickets in KSA. Several studies have been carried out on rickets in KSA.[7-10] However, no attempt to grade the severity of radiological changes with biochemical values had been reported. The present study aims to estimate the incidence of rachitic children among patients attending in King Abdul-Aziz University Hospital (KAUH), Jeddah, KSA, to study their clinical and biochemical profile, and to assess the role of radiological findings in assessing the severity of the disease.

From the Department of Pediatrics, King Abdul-Aziz University Hospital, Jeddah, *Kingdom of Saudi Arabia*.

Received 12th August 2002. Accepted for publication in final form 21st January 2003.

Address correspondence and reprint request to: Dr. Nadia M. Fida, Department of Pediatrics, King Abdul-Aziz University Hospital, PO Box 80215, Jeddah 21589, *Kingdom of Saudi Arabia*. Tel. +966 (2) 6408327. Fax. +966 (2) 6403975. E-mail: nadiafida@hotmail.com

**Methods.** The study was conducted at KAUH, during the period 1997-1999. Symptomatic cases of rickets were referred from well Baby Clinic, General Clinic and Orthopedic Clinic to the author of this study who examined all referred cases and followed them in pediatric clinic. Patient data, which is recorded in format, included nutritional pattern breast and bottle-feeding, developmental milestones, exposure to sunlight, social class, weight, height and presenting signs and symptoms. Cases of nutritional rickets were identified based on clinical signs and symptoms, biochemical values and radiological finding of wrist and knee radiographs.[7,11] Rickets cases secondary to other causes (for example chronic diarrhea, renal disease, epilepsy, prematurity) were excluded. None of the patients were on Vit D3 supplement. Bone profile (Ca, $PO_4$ and ALP values) and x-ray were carried out for the study group upon inclusion and follow-up until healing. The biochemical values (Ca, phosphate [$PO_4$] and alkaline phosphatase [ALP] values) were determined spectrophotometrically using chemical analysis system "Dimension RXL". All radiographs in each series were read by radiologist who was unaware of the clinical and biochemical finding, he reported them into 3 categories: minimal, active, and healed.[11,12] All patients were treated by oral Vit D3 and Ca supplement until they achieved normalization of clinical, biochemical and radiological signs. Statistical analysis was performed using SPSS-10 comparison between means using the appropriate test. Significance was assigned at $p<0.05$.

**Results.** Out of 13,382 children seen at KAUH during 1997-1999, 60 cases were diagnosed as nutritional rickets that gave an incidence of 0.5%. From the 60 cases we have 31 male and 29 female. Age of patients ranged between 3-36 months, the mean age ± SD was 16.9 ± 13.1. **Table 1** shows the classification of rachitic children according to their age at time of presentation. Most patients (40%) had an age between 13-24 months. **Table 2** summarizes the clinical presentation of rachitic patients. Thirty-eight percent of the patients presented with swollen wrists, 28.3% with bowleg, 15% had delayed walking, and other signs were seen in 2-5% of the patients. Radiological studies confirmed the diagnosis of rickets. Twenty-one patients (32%) showed minimal change, 35 patients (53%) had active rickets (evident by cupping, frying) and 4 patients (15%) showed minimal healed rickets. **Table 3** shows the x-ray findings and the percentage of rachitic cases with abnormal biochemical values. It was observed that 81% of the patients had normal calcium, 18.3% had low serum $PO_4$ concentration, 98.3% showed high value of ALP. The percentage of patients with abnormal biochemical values was not significantly different among minimal, active or healed rickets groups. Bone profile (mean ± SD) of the patients regardless of severity was as follows: Ca = 2.33 ± 0.23, mmol/L, $PO_4$ = 1.47 ± 0.40 mmol/L, ALP = 925 ± 418 IU. **Table 4** shows the mean biochemical value of rachitic children classified according to their x-ray findings at presentation; patients with active rickets showed significantly higher mean ALP level compared to other groups ($p=0.39$). No significant different in means of Ca ($p=0.323$) and $PO_4$ ($p=0.296$).

**Discussion.** In this study 60 rickets' children were diagnosed over a 2-year-period gave an incidence of 0.5%. Although this is not a true population based study, no ascertainment by other source was carried out. It reflects that rickets is common. The underlying problem is serious; it might reflect the extent of undiagnosed Vit D3 deficiency in infants and mothers.[13] Incidence of nutritional rickets still prevails inspite of all measures taken to eradicate the disease in many developing countries[14-16] and the disease is still seen in some developed countries.[17] Nutritional rickets in African - American infants were reported to be increasing between the periods of 1990-1999. This was attributed to lack of Vit D supplement for most infants and inadequate exposure to sunlight of both mother and infant.[18] Nutritional rickets without Vit D deficiency has been reported in Bangladesh.[19] In Nigeria, studies suggested that Ca deficiency, Vit D end products resistance maybe the contributing factors. The prevalence of nutritional rickets among Saudi children in Riyadh, KSA during 1986 was estimated as 1.3% and in 1987 it was estimated as 1.4%.[7] A swollen wrist is an early sign of rickets and occurs as a failure of mineralization of the cartilage. Most of our patients presented with a swollen wrist (38.3%) while bowleg was seen in 28.3%; similar findings were reported by Sedrani et al.[7] Less than 10% with bowleg was seen in their study. This might be due to the mean age of our group being older and that the symptoms are more obvious as the child starts to walk, delayed diagnosis and thought of medical advice is the possible cause. However, physiological bowing was not observed in this study as all these patients presented are approximately 2-year-old and had an x-ray findings of classical rickets. Fifteen percent of our patients presented with delayed walking, compared to 5% in Sedrani et al[7] study. It reflects the severe rachitic patient with fully developed muscle and lack of tone. Other manifestations are seen in variable degrees. However, other reported presenting symptoms such as convulsions, fractures are not seen in the present study.

In our study, 18.3% of rachitic children were hypocalcemic and escaped the effect of inappropriate parathyroid response as most of them presented at the age of 15 months, 20% had low serum $PO_4$ concentration, which is attributed to tubular response,[20] and ALP was higher in 98.3%. Sedrani et al,[7] reported a lower percentage of rachitic children who had hypocalcemia (17.2%) or hypophosphatemia (14.2%). A recent study in the United Arab Emirates showed results different from our findings concerning hypocalcemia

Table 1 - Classification of rachitic children according to their age (N = 60).

| Groups | Age (months) | | |
|---|---|---|---|
| | Range | n | (%) |
| 1 | 3 - 6 | 10 | (16.7) |
| 2 | 7 - 12 | 15 | (25) |
| 3 | 13 - 24 | 24 | (40) |
| 4 | 25 - 36 | 11 | (18.3) |
| **Total** | **3 - 36** | **60** | **(100)** |

Table 2 - Clinical presentation of rachitic children.

| Clinical presentations | n | (%) |
|---|---|---|
| Swollen wrist | 23 | (38.3) |
| Bow leg | 17 | (28.3) |
| Delayed walking | 9 | (15) |
| Frontal bossing | 3 | (5) |
| Rachitic rosary | 3 | (5) |
| Hypotonia | 2 | (3.3) |
| Wide fontanel | 2 | (3.3) |
| Delayed teeth | 1 | (1.7) |
| **Total** | **60** | **(100)** |

Table 3 - Relation between x-ray findings of biochemical values and rachitic children.

| X- ray findings N (%) | Calcium normal (2.2 - 2.7) mmol/L n (%) | Phosphate Below 1.1 mmol/L n (%) | Alkaline phosphatase Above 400 IU n (%) |
|---|---|---|---|
| Minimal 21 (35) | 17 (81) | 3 (14.3) | 20 (95.2) |
| Active 35 (58.3) | 29 (82.9) | 7 (20) | 35 (100) |
| Healed 4 (6.7) | 3 (75) | 1 (25) | 4 (100) |
| **Total 60 (100)** | **49 (81.7)** | **11 (18.3)** | **59 (98.3)** |
| p value | 0.924 | 0.813 | 0.004 |
| Significance is assigned at $p < 0.05$ | | | |

Table 4 - Correlation between radiological findings and mean biochemical values in rachitic children.

| X- ray | Calcium | Phosphate | Alkaline phosphatase |
|---|---|---|---|
| Minimal rickets | 2.37 ± 0.30 | 1.56 ± 0.38 | 695 ± 232 |
| Active rickets | 2.34 ± 0.24 | 1.45 ± 0.42 | 1067 ± 452 |
| Healed rickets | 2.18 ± 0.15 | 1.24 ± 0.12 | 889 ± 397 |
| **Total** | **2.33 ± 0.23** | **1.47 ± 0.40** | **925 ± 418** |
| p value | 0.32 | 0.30 | 0.39 |
| Significance is assigned at $p < 0.05$ | | | |

(36%), and hypophosphatemia (82%) among rachitic children.[21] Several studies showed that all rachitic patients had high ALP.[21] The majority of the patients (53%) had a radiological findings, indicative of active rickets, which reflects prolonged and defective mineralization of bones, failure of calcification of bones that result in decreased density of the shaft. Most of patients' ages ranged from 13-24 months, which is the age of maximum growth and need for Vit D3 and Ca. The mean dietary intake of Vit D3 decreases significantly in this age group below 54%. Recommended daily allowance, as estimated by Bahijri,[22] although their exposure to sun increased as they start walking. In our study, 15% of patients had healed rickets. As they were more than 2 year old, and none of them were on Vit D3, it is speculated that as they grow older, they become more dependent on sunlight to provide them with the Vitamin. However, minimal change rickets was found in 32% of our patients who had a mean age of 10 months. This might be due to prolonged breast-feeding, although no significant relationship was found between mean biochemical value of Ca, $PO_4$, ALP and degree of radiological change, the limitation of the study, was the inability to measure 25 hydroxy cholcalciferol which was not available in our hospital.

In conclusion, radiological examination is essential to confirm clinical diagnosis of rickets and the assessment of severity. Raise levels of serum alkaline phosphates remain the important supportive evidence for diagnosis and assessment of severity. Rickets is still a major problem in our community and consumes considerable health resources. We cannot rely on greater exposure to sun and modified diet alone. To control the problem, it is recommended to eradicate rachitic cases by ensuring Vit D3 supplement as well as maintaining adequate calcium level in infancy and high- risk groups. There is a need to launch rickets prevention program awareness of general practitioners, pediatricians, and obstetricians. They must be alerted to the consequences of Vit D3 deficiency. With the availability of assessment of 25 hydroxy cholcalciferol, it is probably cost effective to routinely measure the level in individuals at great risk.

Acknowledgment. To all my colleagues in King Abdul-Aziz University Hospital, Jeddah, Kingdom of Saudi Arabia, who referred their cases: Prof. Elidressy for his time and encouragement, Prof. Samira Islam for her continuous help in reviewing laboratory works, Dr. Ahmed Shaker in performing the statistical analysis, Dr. Hesham Saber, Consultant Radiologist and to the secretarial assistance of Drug Monitoring Unit of King Fahd Medical Research Center, Jeddah, Kingdom of Saudi Arabia.

## References

1. David L, Francis H. Glorieux Common Vitamin D-deficiency rickets: Nestle Nutrition Workshop series. Vol. 21. New York (NY): Nestle Ltd, Raven Press Ltd; 1991. p. 109.
2. Nagi NA. Vitamin D deficiency rickets in malnourished children. ***J Trop Med Hyg*** 1972; 75: 251-254.
3. Jalal OM, El-Nawaby M, Hassan A. Incidence of rickets in two children populations in Egypt. ***Ain Shams Med J*** 1970; 21: 133-137.
4. World Health Organization. Joint FAO/WHO expert committee on Nutrition. ***Tech Rep Ser*** 1967; 377: 32-82.
5. Hojer B, Medhin MG, Sterky G, Zetterstrom R, Daniel K. Combined vitamin D deficiency rickets and protein energy malnutrition in Ethiopian infants. ***Environmental Child Hlth*** 1977; 23: 73-79.
6. Thacher TD, Fischer PR, Pettifor JM, Lawson JO, Isichei CO, Reading JC et al. A comparison of calcium, vitamin D, or both for nutritional rickets in Nigerian children. ***N Engl J Med*** 1999; 341: 563 –568.
7. Sedrani SH, Abanmy A, Salman H, Al Arabi K, El Idrissy A. Vitamin D status of Saudis: Are Saudi children at risk of developing Vitamin D deficiency rickets? ***Saudi Med J*** 1992; 13: 430-433.
8. Elidrissy A. Vitamin D deficiency rickets in a sunny country: Pathogenesis, clinical picture and management. ***Annals of Saudi Medicine*** 1987; 7: 99-125.
9. Abanamy A, Salman H, Chriyan M, Shuja M, Siddrani S. Vitamin D deficiency rickets in Riyadh. ***Annals of Saudi Medicine*** 1991; 11: 35-39.
10. Al-Jurayyan NA, El-Desouki ME, Al-Herbish AS, Al-Mazyad AS, Al-Qhtani MM. Nutritional rickets and osteomalacia in school children and adolescents. ***Saudi Med J*** 2002; 23: 182-185.
11. Behrman RE, Kliegman RM, Arvin AM. Nelson Textbook of Pediatrics. 16th ed. Philadelphia (PA): WB Saunders Company; 2000. p. 184-187.
12. David L. Francis H. Glorieux Common Vitamin D-deficiency rickets: Nestle Nutrition Workshop series. Vol. 21. New York (NY); Nestle Ltd, Raven Press Ltd; 1991. p. 110.
13. Serenius F, El Idrissy A, Dandona P. Vitamin D nutrition in pregnant women at term and in newly born babies in Saudi Arabia. ***J Clin Pathol*** 1984; 37: 444-477.
14. Richard ID, Sweet EM, Arneil GC. Infantile rickets persist in Glascow. ***Lancet*** 1968; 7546: 803-805.
15. Beser E, Cakmakci T. Factors affecting the morbidity of vitamin D deficiency rickets and primary protection. ***East Afr Med J*** 1994; 71: 358-362.
16. VanderJagt DJ, Peery B, Thacher T, Pastuszyn A, Hollis BW, Glew RH. Aminoaciduria in calcium-deficiency rickets in northern Nigeria. ***J Trop Pediatr*** 1999; 45: 258-264.
17. Hayward I, Stein MT, Gibson MI. Nutritional rickets in San Diego. ***Am J Dis Child*** 1987; 141: 1060-1062.
18. Kreiter SR, Schwartz RP, Kirkman HN Jr, Charlton PA, Calikoglu AS, Dabenport ML. Nutritional Rickets in African American breast-fed infants. ***J Pediatr*** 2000; 137: 153-157.
19. Fischer PR, Rahman A, Cimma JP, Kyaw-Myint TO, Kabir AR, Talukder K et al. Nutritional rickets without Vitamin D deficiency in Bangladesh. ***J Trop Pediatr*** 1999; 45: 291-293.
20. Fraser D, Kooh SW, Scriver CR. Hypothyroidism as the cause of hyperaminoaciduria and phosphaturia in human Vit. D3 deficiency. ***Pediatr Research*** 1967; 1: 425-436.
21. Dawodu A, Kadir A, Hardy DJ, Varady E. Nutritional rickets in then United Arab Emirates: an unresolved cause of childhood morbidity. ***Middle East Paediatrics*** 2002; 7: 12-13.
22. Bahijri SM. Serum 25-hydroxy cholecalciferol in infants and preschool children in the Western Region of Saudi Arabia. S***audi Med J*** 2001: 22: 973-979.