

Nutritional rickets and osteomalacia in school children and adolescents (6-18 years) in a major teaching hospital in Riyadh, Kingdom of Saudi Arabia

Nasir A. Al-Jurayyan, FRCPC, FAAP, Mahmoud E. El-Desouki, ABNM, FRCPC, Abdullah S. Al-Herbish, FRCPC, FAAP, Abdullah S. Al-Mazyad, MD, Maha M. Al-Qhtani, MD.

ABSTRACT

Objectives: To review experiences of nutritional rickets and osteomalacia in school children and adolescents at King Khalid University Hospital, Riyadh, Kingdom of Saudi Arabia.

Methods: Records of children and adolescents aged 6-18 years, seen at King Khalid University Hospital, Riyadh, Kingdom of Saudi Arabia, during the period January 1994 through to December 1999, who were diagnosed to have rickets or osteomalacia were reviewed. The diagnosis was based on clinical, biochemical and radiological data. Data extracted and analyzed included age, sex, presenting symptoms and signs, dietary history and sun exposure, blood count, bone profiles, renal and liver profile, and 25-hydroxy vitamin D3 and 1, 25 dihydroxy vitamin D3. Hand and wrist x-rays were carried out for all patients while bone density of lumbar spine and 3 femoral sites and bone scan were performed on the majority of patients.

Results: Forty-two children and adolescents (25 females and 17 males) were diagnosed. Their age ranged between 6-18 years with a mean of 13.5. Non specific symptoms, such as bone pain and fatigue were the most presenting symptoms, while skeletal deformities and fractures were the presenting symptoms in only 5 and 3 patients. Lack of direct sun exposure and poor calcium intake was evident.

Bone profiles at the time of diagnosis revealed mean serum calcium of 2.1 mmol/L, range 1.5- 2.3 (Number=2.2-2.7), phosphorus 1.1 mmol/L, range 0.7-1.9 (Number=1.4-2.1) and alkaline phosphatase activities of 1,480 U/L, range 834 - 2,590 (N=<600). Serum concentrations of 25-hydroxy Vitamin D were low (<10 ng/L) while that of 1, 25 Dihydroxy Vitamin D varied between low to normal (<10-45 ng/L). Bone density of the lumbar spine and 3 femoral sites were performed in 26 patients and showed markedly reduced values, while bone scan demonstrated a high uptake of tracer throughout the skeleton "super scan". Multiple stress fractures were evident in 8 children.

Conclusion: Although a community-based study to assess the magnitude of the problem is needed, it seems that rickets and osteomalacia of nutritional origin are not that uncommon and deserves special attention from all pediatricians and practicing physicians. Further studies are needed to help understand the pathophysiology, and identify the contributing factors for the development of the disorder.

Keywords: Rickets, children.

Saudi Med J 2002; Vol. 23 (2):

Rickets and osteomalacia are anatomically distinct conditions arising from the common event of mineral insufficiency. Rickets is often referred to as

failure of mineralization of a growing bone, whereas osteomalacia indicates failure of a mature bone to mineralize.^{1,2} In developing countries, nutritional

From the Department of Pediatrics (Al-Jurayyan, Al-Herbish, Al-Mazyad & Al-Qhtani), Department of Nuclear Medicine (El-Desouki), College of Medicine and King Khalid University Hospital, King Saud University, Riyadh, Kingdom of Saudi Arabia

Received 15th May 2001. Accepted for publication in final form 30th September 2001.

Address correspondence and reprint request to: Dr. Nasir A. Al-Jurayyan, Department of Pediatrics, College of Medicine and King Khalid University Hospital, King Saud University, PO Box 2925, Riyadh 11461, Kingdom of Saudi Arabia. Tel. +966 (1) 4671303. Fax. +966 (1) 4679463. E-mail: Jurayyan@yaho.com

Rickets in Saudi school children and adolescents ... Al-Jurayyan et al

rickets is still being seen in infants and toddlers in such a magnitude as to be considered a community health problem.^{1,2-23} In older children and adolescents it is also reported with increasing frequency.^{1,19,24-26} In sunny Saudi Arabia, there is no precise clinical data on the magnitude of the disease in older children and adolescents. However, there is an impression fostered by the clinical experience that this is not uncommon. This article reviews our clinical experience with nutritional rickets and osteomalacia in school children and adolescents (6-18 years) at the King Khalid University Hospital (KKUH), Riyadh, Saudi Arabia over a 6 year period January, 1994 through to December 1999.

Methods. Children and adolescents aged 6-18 years who were seen at the KKUH during the period January 1994 through to December 1999, and confirmed to have nutritional rickets or osteomalacia were included. In this study, KKUH is the major teaching hospital of the King Saud University, Riyadh, Kingdom of Saudi Arabia (KSA) and provides primary, secondary and tertiary health care services to the local population and also receives patients referred from all over the country. The diagnosis was based on clinical, biochemical, and radiological data. Rickets and osteomalacia associated with Vitamin D dependency, renal or liver disorders malabsorption and drug therapies such as steroid or anti-convulsant medications were excluded by appropriate clinical and laboratory investigations.

The records of all patients were reviewed and data extracted for analysis included age, sex, presenting symptoms and signs, dietary history, sun exposure and medication intake as well as detailed physical examination. Laboratory investigations included complete blood count, renal, liver and bone profiles. Serum concentrations of 25 hydroxy Vitamin D (25 [OH] D) and 1, 25 dihydroxy Vitamin D (1,25 (OH) 2 D), were measured commercially by Bio-Scientia Laboratory, Germany. Parathyroid hormones (PTH) level was carried out if indicated. Hand and wrist x-rays were carried out for all patients while other x-rays were carried out when appropriate. Bone density of the lumbar spine and 3 femoral sites and bone scans were performed in 26 patients as described before.²⁶ All patients were treated with oral Vitamin D preparations, \pm calcium supplement with proper sun exposure.

Results. During the period January 1994 through to December 1999, 42 children and adolescents (25 females and 17 males) were diagnosed to have nutritional rickets or osteomalacia. Their ages ranged between 6 and 18 years with a mean of 13.5 years. Non-specific symptoms, such as bone pain and fatigue were the most presenting symptoms in 27 (64.3%) patients. Short stature in 6 (14.3%), while

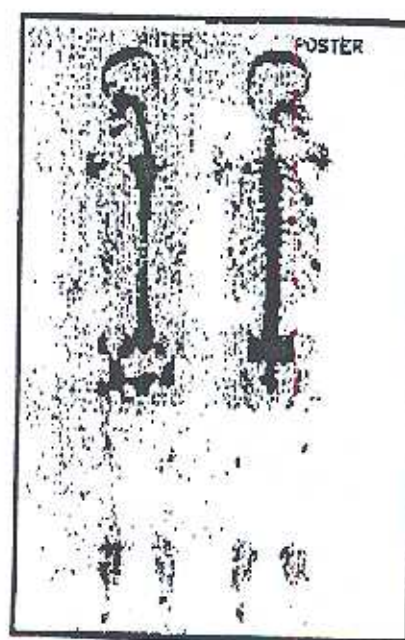


Figure 1 - Bone scan of a patient with osteomalacia demonstrating high uptake of tracer throughout the skeleton "superscan" with multiple focal lesion caused by pseudofractures.

skeletal deformities and pathological fractures were the presenting symptoms in 5 (11.9%), and 3 (7.1%) patients. Only one patient presented with hypocalcemic tetany (2.4%). The dietary calcium intake was estimated to be as low as 100-300 mg/day. Milk consumption was generally low, with increased consumption of fast food and soft drinks. Sun exposure was negligible and the majority of activities were indoors. Bone profiles at the time of diagnosis revealed mean serum calcium of 2.1 mmol/L, range 1.5-2.3 (N=2.2-2.7), phosphorous 1.1 mmol/L, range 0.7-1.9 (N=1.4-2.1), and alkaline phosphatase activities of 1480 U/L, range 834-2590 (N=<600). Serum concentrations of 25-hydroxy Vitamin D (25 [OH]D) were <10ng/L (N, 10-40) and 1,25 dihydroxy vitamin D [1,25 (OH)2D] varied between <10-45 ng/L (N=15-50). Bone scan showed the feature of "superscan" in all patients and demonstrated multiple stress fractures in 8 (Figure 1). The mean and standard deviation (SD) of bone mineral density (BMD) for the lumbar spine were 0.53 ± 0.23 g/cm² (N, 0.91 ± 0.11) with a z-score of -3.1, and for the femoral neck 0.55 ± 0.13 g/cm² (N, 0.86 ± 0.11) with a z-score of -2.8.

Discussion. Nutritional rickets causes considerable disability among children. Though virtually eliminated from Europe and North America by the fortification of foods with Vitamin D, nutritional rickets remains prevalent in many parts of the world, including Africa and Asia.^{5,27-29} Rickets has been ranked among the 5 most prevalent diseases

among infants and toddlers.¹ During periods of rapid growth as in late childhood and adolescents, rickets or osteomalacia might appear as a problem in association with a relative deficiency of Vitamin D or other nutrients necessary for bone mineralization.^{1,2,3-5,22,23} This was supported by Shih²⁴ who reported a high incidence of osteomalacia in adolescent Chinese approximating 5%-15%, particularly in the later part of the cold season.²

In KSA, the overall prevalence of the disease is not known, however, the relatively high number of patients in this series readily supports the contention that this is not an uncommon disease. Furthermore, the majority of our patients were presented with non specific symptoms, which indicates the difficulty in making the clinical diagnosis in most of the less severe conditions. Although, low 25 hydroxy vitamin D [25(OH)D] levels do not necessarily reflect a physiological deficiency in a particular patient.²⁵ Sedrani,²⁶ in a survey of the Vitamin D status of the Saudi population has shown that a very substantial portion of school children and adolescents have inadequate plasma concentrations of 25 hydroxy vitamin D [25(OH)D].

Our patients had the classical biochemical and radiological characteristics of rickets or osteomalacia with abnormal bone density and low levels of 25 (OH)D and low to normal, 1, 25(OH)2D indicating that they were Vitamin D deficient. Rapid change in lifestyle and nutritional habits in the young where fast food and soft drinks consumption is increasing can not solely explain this. The contribution of dietary Vitamin D to the total circulating pool of 25 (OH)D has been found to be almost negligible in relatively sunny countries.²⁷ Nevertheless, avoiding sun exposure, and spending more time in indoor activities could be considered as a major factor. Traditional dressing of women was found not to affect Vitamin D status as shown by Sedrani et al²⁶ who showed that 25(OH)D levels of males and females students were similar. Also, school girls from the age of 6-19 years did not show a drop in 25 (OH)D levels coinciding with the change to traditional dress taking place at puberty.²⁸ Therefore, we are uncertain as to whether Vitamin D deficiency alone or some other factors such as low calcium intake contribute to this. Calcium deficiency has been suggested as a cause of rickets in children with apparently good exposure to sunlight in Nigeria and Bangladesh.^{12,29,30}

The majority of patient's diet is lacking in dairy products and it is estimated that the average daily calcium consumption to be 100-300 mg which was well below the daily allowance of 800 mg recommended by the National Institute of Health (NIH).^{31,32} Decreased bone mineral density and osteopenia might be a feature of decreased calcium intake in our children. Bone density of the lumbar spine and femoral neck were markedly reduced in our

patient. El Desouki³³ has shown that bone mineral density in Saudi children and adolescents is lower compared to caucasian American. Furthermore, some of our patients had low serum levels of calcium and high normal serum phosphorous with markedly increased parathyroid hormone levels (PTH) which might indicate chronic calcium depletion.³⁴ Clements et al³⁵ has shown in animal studies that a low calcium diet promoted Vitamin D deficiency through increase in 1, 25 (OH)2D production in response to secondary hyperparathyroidism which caused hepatic conversion of Vitamin D to polar inactivation products that are excreted in the bile.

Finally, more detailed research needs to be considered to confirm our findings. Special attention should be given to preventive measure through education and appropriate supplements of Vitamin D and minerals. Outdoor activities with direct or indirect exposure to sunlight are to be encouraged and supervised.

Acknowledgment. The author would like to thank Ms. Cecile S. Sacl and Ms. Loida D. Manalo for their secretarial assistance.

References

- Harrison HE, Harrison HC. Rickets and osteomalacia. In: Schaefer AJ, Markowitz M, editors. Disorders of calcium and phosphate metabolism in childhood and adolescence. Philadelphia (PA): WB Saunders; 1979. p. 141-256.
- Parfitt AM. Osteomalacia and related disorders. In: Avioli LV, Krane SM, editors. Metabolic bone disease and clinically related disorders. 2nd ed. Philadelphia (PA): WB Saunders 1990. p. 329.
- Pit MJ. Rickets and osteomalacia. In: Resnick D, Niwayama G, editors. Diagnosis of bone and joint disorders. 2nd ed. Philadelphia (PA): WB Saunders 1988. p. .
- Wharton BA. Diagnosis and presentation of rickets. *Arch Paediatr* 1995; 84: 848.
- Glorieux FH. Rickets of nestle nutrition workshop series. Vol. 21. New York (USA): Raven Press; 1991. p. 7.
- Kanis JA. Vitamin D metabolism and its clinical application. *J Bone Joint Surg (Br)* 1982; 64: 542-561.
- Utiger RD. The need for more vitamin D (editorial). *N Engl J Med* 1998; 338: 828-829.
- Holmes AH, Enoch BA, Taylor JL, Jones ME. Occult rickets and osteomalacia among the Asian immigrant population. *Q J Med* 1973; 42: 125-149.
- Salimpour R. Rickets in Tehran: study of 200 cases. *Arch Dis Child* 1975; 50: 63-66.
- El-Idrissy AT, Sedrani SH, Lawson DEM. Vitamin D deficiency in mothers of rachitic infants. *Calcif Tissue Int* 1984; 36: 266-288.
- Taha SA, Dost SM, Sedrani SH. 25 hydroxy vitamin D and total calcium: extraordinary low plasma concentration in Saudi mothers and their neonates. *Ped Res* 1984; 18: 739-741.
- El-Idrissy AT. Vitamin D deficiency rickets in sunny country: pathogenesis, clinical picture and management. *Annals of Saudi Medicine* 1987; 7: 119-125.
- El-Idrissy AWTH. Vitamin D deficiency rickets in Saudi Arabia. In: Glorieux FH, editor. Rickets of Nestle nutrition workshop series. Vol. 21. New York (USA): Raven Press; 1991. p. 223-229.

Rickets in Saudi school children and adolescents ... Al-Jurayyan et al

14. Abanamy A, Salman H, Cherian M et al. Vitamin D deficiency rickets in Riyadh. *Annals of Saudi Medicine* 1991; 11: 35-39.
15. Mulla PM, Imseeh GW. Convulsions as a possible manifestation of vitamin D deficiency rickets in infants one to six months of age. *Annals of Saudi Medicine* 1992; 12: 34-37.
16. Al Mugeiren MM. Fever and convulsions as a manifestation of vitamin D deficiency rickets in children. *Biomedical Res* 1996; 7: 185-188.
17. Lubani MM, Al Sahb TS, Al Saleh QA et al. Vitamin D deficiency in Kuwait: the prevalence of a preventable disease. *Ann Trop Paediatr* 1989; 3: 134-139.
18. Ahmad I, Aliq M, Iqbal J et al. Vitamin D deficiency rickets in breast fed infants presenting with hypocalcemic seizures. *Acta Paediatr* 1995; 84: 941-942.
19. Zhou H. Rickets in China. In: Glorieux FH, editor. Rickets of nestle nutrition workshop series. Vol. 21. New York (USA): Raven Press; 1991. p. 253-256.
20. Bhattacharyya AK. Nutritional rickets in the tropics. *World Rev Nutr Diet* 1992; 67: 140-197.
21. Walker ARP. Etiology of nutritional rickets; geographic variations (letter). *J Paediatr* 1997; 30: 501-503.
22. Fischer PR, Rahman A, Cimma JP et al. Nutritional rickets without vitamin D deficiency in Bangladesh. *J Trop Paediatr* 1999; 55: 291-293.
23. Thecher T, Glew RH, Isichei C et al. Rickets in Nigerian children: response to calcium supplementation. *J Trop Paediatr* 1999; 45: 202-207.
24. Ford JA, Colhoun EM, McIntosh WB, Dunigan ME. Rickets and osteomalacia in the Glasgow, Pakistani Community, 1961-71. *Br Med J* 1972; 2: 677-680.
25. Shih HZ. Late on-set rickets. *J Prac Pediatrics* 1986 1: 288-289.
26. El-Desouki M, Al Jurayyan N. Bone mineral density and bone scintigraphy in children and adolescents with osteomalacia. *Eur J Nuc Med* 1997; 24: 202-205.
27. Kaper BP, Romness MJ, Urbanek PJ. Nutritional rickets: report of four cases diagnosed at orthopaedic evaluation. *Am J Orthop* 2000; 29: 214-218.
28. Kreiter SR, Schwartz RP, Kirkman HN Jr et al. Nutritional rickets in African American breast-fed infants. *J Pediatr* 2000; 137: 153-157.
29. Davis M, Lawson DeM, June RT. Low plasma 25-hydroxy vitamin D without osteomalacia. *Lancet* 1978; 1: 820.
30. Sedrani SH. Are Saudis at risk of developing vitamin D deficiency? *Saudi Med J* 1986; 7: 427-433.
31. Poskitt EME, Cole TJ, Lawson DEM. Diet, sunlight and 25 hydroxy vitamin D in healthy children and adults. *Br Med J* 1979; 1: 2221-2223.
32. Sedrani S, El-Idrissy ATH, El Arabi KM. Sunlight and vitamin D status in normal Saudi subjects. *Am J Clin Nutr* 1983; 36: 129-132.
33. El-Idrissy AWTH, Abdullah MA, Sedrani SH, Kurar ZA, Arabi KM. Vitamin D in school girls in Riyadh. In: Norman AW editor. Vitamin D-chemical, biochemical and clinical update. ; Berlin de Gruyter; 1985. p. 561-562.
34. Okonofua F, Gill DS, Alabi ZO, Thomas M, Bell JL, Dandona P. Rickets in Nigerian children: a consequence of calcium malnutrition. *Metabolism* 1991; 40: 209-213.
35. Optimal calcium intake. In: NIH consensus statement. Vol. 12. No. 4. Bethesda (MD); NIH Office of Medical Applications of Research; 1994. p. 31.
36. Fraser DR. Physiology of vitamin D and calcium homeostasis. In: Glorieux FH editor. Rickets of Nestle Nutrition Workshop Series. Vol. 21. New York (USA): Raven Press; 1991. p. 23-31.
37. El Desouki MI. Measurement of bone mineral density of the lumbar spine and femur in normal Saudi children and adolescents using dual x-ray absorptiometry. *Saudi Med J* 1999; 20: 95-99.
38. Rao S, Parfitt AM, Kleerekoper M, Puro BS, Frame B. Dissociation between the effects of endogenous parathyroid hormone on adenosine 3, 5, monophosphate generation and phosphate reabsorption in hypocalcemia due to Vitamin D depletion: an acquired disorder resembling pseudohypoparathyroidism type II. *J Clin Endocrinol Metab* 1985; 61: 285-290.
39. Clements MR, Johnson L, Fraser Dr. A new mechanism for induced vitamin D deficiency in calcium deprivation. *Nature* 1987; 325: 62-65.

Paper no 20010/79

المختصات العربية

لين العظام لدى الأطفال واليافعين بالمدارس بالمملكة العربية السعودية
ناصر عبد الله الجريان، محمود إبراهيم الدسوقي، عبدالله سليمان الحربش، عبدالله سليمان
العزيد، مها القحطاني (جامعة الملك سعود، كلية الطب ومينشفي الملك خالد الجامعي، الرياض، السعودية)

ملخص

الهدف : ايضاح خبرة مستشفى الملك خالد الجامعي بالرياض في حالات لين العظام لدى
الأطفال واليافعين .
الطريقة : تمت مراجعة ملفات الأطفال واليافعين (٦-١٨ سنة) بمستشفى الملك خالد
الجامعي للفترة من يناير ١٩٩٤م إلى ديسمبر ١٩٩٩م والذين تم تشخيصهم بلين عظام . بنى
التشخيص على المعطيات السريرية والكيميائية والإشعاعية . وقد شملت المعلومات المدروسة
العمر و الجنس والعلامات السريرية وتعداد كريات الدم والكالسيوم ووظائف الكلى والكبد
بالإضافة إلى مستوى ٢٥ هيدروكسي فيتامين (د) و ٢٥,١ ثنائي هيدروكسي فيتامين (د) . هذا
وقد قيست كثافة العظام للعمود الفقري وعظام الفخذ إضافة إلى الأشعة النووية للعظام لبعض
المرضى.

النتائج : تم دراسة ٤٢ طفلاً وياًفعا (٢٥ أنثى و١٧ ذكر) والذين قد شخضوا بلين العظام
الغذائي حيث كانت أعمارهم تتراوح بين ٦ و١٨ سنة (المعدل ١٣,٥) وكان معظمهم يعانون
من أعراض غير محددة مثل آلام العظام والتعب العام وخمسة فقط منهم كان لديهم تشوهات
بالتشكل العظمي وثلاثة لديهم كسور بالعظام . هذا وكان واضحاً جداً أن تعرضهم للشمس
وكمية الكالسيوم بالغذاء قليلان جداً . كان معدل الكالسيوم لديهم ٢,١ ملمول/لتر (١,٥-٢,٣)
حيث المعدل الطبيعي هو ٢,٢-٢,٧ والفوسفات ١,١ ملمول/لتر (١,٧-١,٩) حيث المعدل
الطبيعي هو ١,٤-٢,١ والفوسفات القاعدي ١٤٨٠ وحدة/لتر (٨٣٤-٢٥٩٠) حيث المعدل
الطبيعي أقل من ٦٠٠ وكان مستوى ٢٥ هيدروكسي فيتامين (د) منخفضاً (أقل من ١٠ ما يكر
وجرام/ لتر) أما مستوى ٢٥,١ ثنائي هيدروكسي فيتامين (د) متراوح بين المنخفض والطبيعي
(أقل من ١٠-٤٥ نانوجرام/لتر) هذا وقد قيست كثافة العظام للعمود الفقري وعظام الفخذ
لدى ٢٦ مريضاً حيث أعطت معدلات منخفضة جداً بينما أوضحت الأشعة النووية للعظام

نشاطاً عالياً في جميع أجزاء الهيكل العظمي ووجد أن ثمانية مرضى لديهم كسور جبهية متعددة.

خاتمة : بالرغم أننا بحاجة إلى دراسة ميدانية لمعرفة حجم المشكلة إلا أن لين العظام الناتج عن نقص فيتامين د ليست بالقليلة في هذا المجتمع. أن هذه المشكلة تستحق اهتمام أطباء الأطفال بل وجميع الأطباء الممارسين هذا ويحتاج المجتمع إلى دراسات إضافية لفهم أسباب هذه المشكلة بطريقة أوضح وأدق.

المجلة الطبية السعودية ٢٠٠٢م، المجلد (٢٣) العدد ٢

مفتاح الكلمات: لين العظام، أطفال، سعوديون.

المجلة الطبية السعودية ٢٠٠٢م، المجلد (٢٣) العدد ٢