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Vitamin D Deficiency in Mothers of Rachitic Infants

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Summary. The existence of nutritional deficiency rickets among infants in sunny Riyadh was confirmed radiologically. Most of the rachitic infants were breast-fed, some received unsupplemented infant feeding formulae, and all live in an environment that is devoid of sunlight. Their mean age at the time of onset was 10.5 months. 25-Hydroxyvitamin D (25OHD) levels were found to be low in mothers of the rachitic infants. This maternal deficiency as a factor in pathogenesis of rickets in the infant is discussed. Proposals are made to prevent the occurrence of rickets on this scale.

Key words: Rickets — 25-Hydroxyvitamin D (25OHD) — Vitamin D deficiency.

Although it is sunny all the year round in Riyadh, the capital of Saudi Arabia, vitamin D deficiency rickets is not uncommon, mainly among breast-fed infants [1]. As breast-fed infants are usually in close contact with their mothers, we postulated that the mother as well as the baby would be vitamin D deficient. In pursuing this hypothesis we found that Saudi Arabian pregnant women and their newborn infants have low levels of 25OHD. [2,3]. This study was carried out to further elucidate the relation between infantile rickets and maternal vitamin D status.

Patients and Methods

The study group included 36 infants with clinical diagnosis of rickets which was radiologically confirmed. The method of feeding, type of house, attitude, and history of exposure to the sun were recorded in each case. Samples of blood were collected from the rachitic infants and their mothers. The serum was separated and stored at −20°C for subsequent analysis. Similarly treated control samples were collected from nonrachitic hospitalized children and from nonpregnant adult females.

After extraction of 25OHD, it was purified using sephadex LH-20. The 25OHD concentration was estimated using protein binding assay [4]. Calcium, phosphorus, and alkaline phosphatase were estimated by the standard methods in some and by SMAC autoanalyzer in others. The results obtained were processed using a computerized statistical analysis system (SAS) for "t" and Pearson tests.

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Results

The ages of the 36 children in the study ranged from 4–28 months with a mean age of 10.5 months. All except 3 were breast-fed. They all came from crowded parts of the city, living either in flats or traditional mud houses. Some mothers were of the opinion that sunlight hurts the child and all kept their children at all times almost completely covered by wrapping them tightly and keeping them indoors.

Of the children with clinically diagnosed rickets, 19 had serum 25OHD levels of less than 7.2 ng/ml with a mean of 3.7 ± 2.3 ng/ml, and Ca and P levels of 8.2 ± 0.9 mg/100 ml and 3.2 ± 1.6 mg/100 ml, respectively. These results are consistent with active rickets and that was confirmed radiologically. In the remaining children, the plasma 25OHD values ranged from 8.3–163.0 ng/ml with a mean of 16.1 ± 10.2 ng/ml, and X-ray films of the long bones showed evidence of healing. In nonrachitic children, mean plasma 25OHD was 23.8 ± 38.1 ng/ml. Calcium and phosphorus levels were 9.3 ± 0.6 mg/100 ml and 4.4 ± 0.7 mg/100 ml, respectively. All the mothers except one had a plasma 25OHD level of less than 10 ng/ml, with a mean concentration of 5.2 ± 2.5 ng/ml. This compares with a mean

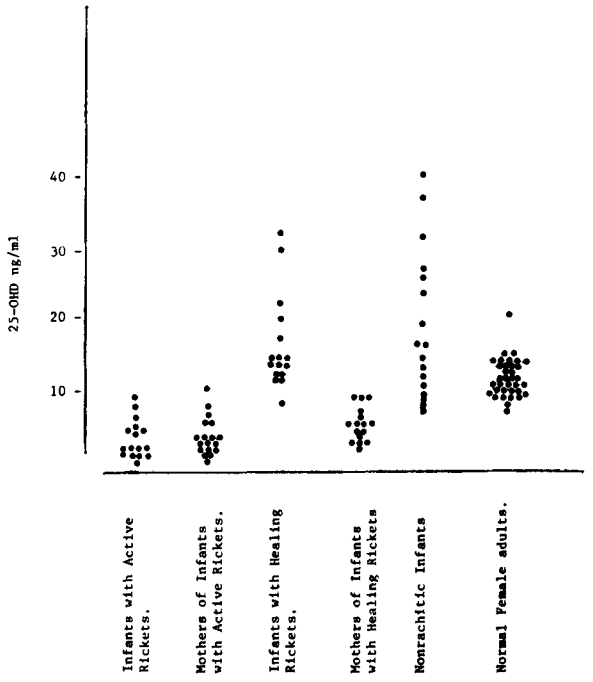

Fig. 1. 25-hydroxyvitamin D levels in rachitic infants, their mothers, nonrachitic children and normal adult females.

value for the female nonpregnant adults of 11.4 ± 2.8 ng/ml. The 25OHD levels are shown in Fig. 1. These findings show a statistically significant difference between children with active rickets and the control group. Also there is a significant vitamin D deficiency level in mothers of the rachitic infants as compared with the normal levels in the control adult females. There was no correlation between the levels of 25OHD and calcium/phosphorus in this study.

Discussion

Despite the sunny climate in Saudi Arabia, our results demonstrate a state of vitamin D deficiency among mothers of infants who presented with nutritional rickets. Although the infants with evidence of healing have shown normal levels of 25OHD, the levels of their mothers remained below normal. Some of the infants in this group were given vitamin D supplements in the form of teething medicine, as delay in teething is a common minor complaint for which vitamin D is given, occasionally in very high doses (demonstrated by the very high levels of 25OHD).

The low vitamin D status found in this study of the mothers and their infants is a consequence of the Saudi Arabian custom of avoiding the hot sunshine. This is aggravated by the design of housing which does not provide the seclusion necessary for them to expose even face and hands to the sun. For the infants, the custom of wrapping them tightly and almost completely again limits their exposure to sunshine. The low vitamin D content of the Saudi diet also limits the usefulness of this source of vitamin D for the women [5].

Consequently, in view of the low 25OHD levels of such women, their infants will also be born with inadequate levels, and a proportion will subsequently develop rickets [7, 9]. Interestingly, some breast-fed infants developed the disease even when their mothers had plasma 25OHD levels in the range 4.7–11.4 ng/ml, a finding consistent with recent studies refuting the value of milk as a good source of antirachitic activity [10–14]. It further suggests that the disease has its origin in the prenatal period, and that it only rarely occurs beyond 2 years, the age at which the infant is active and can be exposed to the sun, thereby synthesizing his or her own vitamin D. This is further supported by the low incidence of rickets in rural Saudi Arabia [1] which can be explained by the fact that the houses have yards where the mother and infant can be exposed to the sun while maintaining their privacy.

Rickets, of course, is a preventable disease and this was achieved in the temperate countries by fortifying infant formulae with vitamin D. In the sunny countries where synthesis by the action of ultraviolet rays is the natural source of vitamin D [14], exposure to direct sunlight remains the most effective measure for preventing rickets. This can be achieved among the town-dwellers by allowing more time outdoors and abandoning the overwrapping of infants. Over a long term, an adequate vitamin D status in Saudi women can be achieved in a culturally acceptable manner by changing the design of houses to allow exposure to sunlight in privacy and by having public play areas for children. As an immediate measure, vitamin D supplementation should be available for both mothers and infants. This can be achieved by compulsory vitamin D fortification of milk available for general consumption. This should result in an improvement of the vitamin D status of mothers and thereby of their newborn infants who might not then need extra supplies for the first 6 months of life [15].

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