Editorial

Vitamin D and/or Calcium Deficiency Rickets in Infants and Children: A Concern for Developing Countries?

The paper by Bhalala and coworkers, published in the current issue of the journal, emphasizes a topic that has been causing growing concern among nutritionists, pediatricians and public health specialists in many part of the world: The poor vitamin D status of mothers and their children(1). Globally, there has been renewed interest and attention focused not only on the roles of vitamin D status and calcium intakes in the prevention of rickets and osteoporosis, but also on the role of vitamin D in the reduction of cancer risk, immune related disorders, and infectious diseases(2).

With this renewed interest has come a major push, especially from researchers in the USA, to increase the generally accepted 25-hydroxyvitamin D [25(OH)D] reference values for categorising vitamin D status (deficiency, insufficiency and sufficiency)(3). The pediatric literature has to a certain extent been carried along on the coat tails of the adult enthusiasm for increasing the upper limit for vitamin D deficiency and the lower limit for vitamin D sufficiency, however a recent review still suggests vitamin D deficiency should be defined as 25(OH)D values <25 nmol/L (10 ng/mL) and vitamin D insufficiency between 25 and 50 nmol/L (4). The data that are available from children currently support these later recommendations as most reports on vitamin D deficiency rickets document 25(OH)D levels <25 nmol/L in those with active bone disease(5). The use of varying cut off points for vitamin D deficiency and insufficiency by different authors has made it difficult to compare the results of research published by different authors and has further complicated comparisons between different communities and populations. Thus until there is more evidence to the contrary in children, it would seem prudent to continue to use the traditional cut-off values of 25(OH)D in defining vitamin D status.

Vitamin D deficiency in India has only recently received the attention it deserves, as there has been a general belief that rickets and vitamin D deficiency are uncommon problems in children(6), especially in southern India. There is, however, now increasing evidence that this is not true. In Delhi, over 80% of young children (9-30 months of age) from two slum areas had 25(OH)D values <35 nmol/L, while surprisingly only 2% of children living in another area in the city had similarly low levels(7). A study of Delhi school children (10-18 years of age) revealed that over one third had 25(OH)D values <9 ng/mL (<22.5 nmol/L) with the prevalence being higher in those children from low socio-economic backgrounds and in females(8). In a more recent study from New Delhi, almost 30% of schoolchildren between 6-18 years of age had values in a similar range(9). Over 60% of healthy adults living in the same city had 25(OH)D values ≤9 ng/mL (≤22.5 nmol/L)(10). From a study in Lucknow, it appears that vitamin D deficiency is the primary cause of rickets/ osteomalacia in adolescent females, while dietary calcium deficiency plays an important role in the development of rickets in younger children(10). From the same city, 42.5% of pregnant women from lower and middle social classes had 25(OH)D values <25 nmol/L during autumn, while the mean cord blood 25(OH)D value of the total cohort was only 21 nmol/L(11). The degrees of melanin pigmentation, sun exposure and skin coverage by clothing appear to be important in the pathogenesis of vitamin D deficiency(12), but another factor, that of atmospheric pollution, has also been suggested as cause in large cities, such as Delhi(13). In south India, the prevalence of vitamin D deficiency is less severe, although there is less information. In both urban males and females and rural females mean serum 25(OH)D concentrations were below 50 nmol/L (*i.e.*, in the vitamin D insufficiency range)(14). From the data provided, it was not possible to calculate the percentage of subjects with 25(OH)D concentrations below 25 nmol/L. Urban adults had lower 25(OH)D and higher alkaline phosphatase values than rural adults, although the parathyroid hormone concentrations were similar in the groups(15).

There is increasing evidence that dietary calcium intakes play a role in the pathogenesis of nutritional rickets(16). Low calcium intakes increase the catabolism of 25(OH)D through the activation of 24-hydroxylase as a consequence of elevated 1,25-dihydroxyvitamin D ($1,25(OH)_2D$) concentrations (17), thus a low calcium intake may precipitate vitamin D deficiency in a child who had a marginal vitamin D status to start with. Furthermore, there is evidence that low calcium intakes might increase vitamin D requirements through another mechanism, as higher levels of 25(OH)D might be required to maintain optimal elevated concentrations of $1,25(OH)_2D$ to ensure maximal absorption of the low intestinal calcium content(18). Finally, low calcium intakes (around 200 mg/d) have been shown to be responsible for rickets in the face of what is generally considered to be an adequate vitamin D status(19;20). Calcium intakes of the majority of children in India are similar to those reported from other developing countries, where following weaning, dairy product ingestion is limited by availability and price. It is thus not surprising that reports are appearing from India which suggest that in young children low dietary calcium intakes might play a role in the pathogenesis of rickets in this age group(20).

During a recent symposium on Nutrition and Bone Health organised by the Nutrition Foundation of India held in New Delhi in August this year, it became apparent that several areas of research need to be undertaken to delineate the problem of vitamin D deficiency and rickets in India's women of child bearing age and children:

- There is an urgent need for more epidemiological community based studies to determine circulating 25(OH)D concentrations in pregnant mothers, infants and children of all ages to determine the true prevalence of vitamin D deficiency in the pediatric population of India.
- Studies should be conducted to determine the amount of sunlight exposure needed to prevent vitamin D deficiency in the pediatric age range. These studies need to be conducted in both north and south India during the summer and winter months as it remains unclear if the differences in latitude between the two regions make a significant difference in prevalence of vitamin D deficiency among women of child bearing age, and children and adolescents.
- Studies also need to be conducted on the dose of oral vitamin D that is needed to maintain normal 25(OH)D concentrations, especially in the light of suggestions that the normal range of 25(OH)D is higher than that previously considered. This is particularly relevant if vitamin D deficiency during pregnancy is to be prevented.
- There is little or no information on the influence of habitually low dietary calcium intakes on vitamin D requirements and the maintenance of vitamin D sufficiency. Further, the magnitude of the problem of nutritional rickets due primarily low dietary calcium intakes in not known.

Although the clinical presentation and treatment of nutritional rickets are well known, there is less clarity on the best methods of prevention especially at a community or population level. Considerable research needs to be undertaken to ascertain the best and more effective and applicable methods to combat what appears to be a major public health problem in most if not all areas of India. Furthermore, as our understanding of the roles of vitamin D in human physiology increases, we need to be conscious that besides its role in bone and calcium metabolism, it may be an important factor in decreasing the incidence and severity of infectious diseases in childhood and the incidence of a number of important diseases such as diabetes and specific forms of cancer in adulthood.

Funding: Nil.

Competing Interests: None stated.

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