Nutritional Rickets – Ancient Malady or Modern Public Health Scourge?

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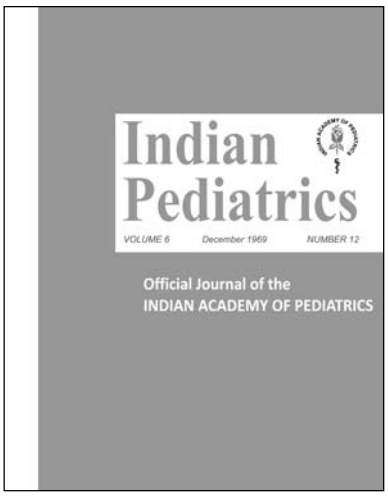
As smog envelopes large parts of India, this is an appropriate time to recall a paper from the December 1969 issue of Indian Pediatrics – "Rickets – a study of 300 cases" [1]. This study aptly illustrates the epigram "*plus ca change, plus c'est la meme chose*" – "The more things change, the more they remain the same" (Jean-Baptiste Alphonse Karr, Les Guepes, July 1848). Many of the comments made half a century ago might be apt for the current status of rickets.



THE PAST

The study: Agarwal, *et al.* [1] described the profile of 300 children with clinical rickets from all admissions (mostly respiratory or gastrointestinal symptoms, or convulsions) to the pediatric wards of Nair Hospital, Mumbai, and found "clinical rickets in 300 of 5621 admissions, giving an incidence of 5.3%." Even this high incidence would grossly underestimate vitamin D deficiency (VDD) as assays of 25-hydroxy vitamin D3 (25OHD3) were not easily available. Succinct observations of these authors are still relevant. They wrote "rickets predisposes to tetany and recurrent gastrointestinal and respiratory tract infections, retards growth and development, and triradiate/contracted pelvis as a sequel of mismanaged pediatric care in infancy and childhood." Back in 1969, they noted "rickets is almost universal in India and found in all strata of society. The erroneous idea that is it rare in the tropics has to be corrected." Yet to this day, bureaucrats – even physicians – say that the sunshine vitamin cannot be deficient in a sunny country. Five decades ago, they elucidated why this was so – presence of extra pigment in the skin, the dust and smoke in the atmosphere of big cities like Bombay, spending most of one's time indoors, and covering the child with clothes while outdoors leaving no scope for generating vitamin D. Studies showing deficiency in children, pregnant women [2], and adults have validated that "if only the medical practitioners become conscious of the caloric, mineral and vitamin requirements of pregnant women and infants and implement it in their day to day practice, a major progress in pediatric care would be achieved." They also note this is not difficult. Under ordinary circumstances, a growing child should receive 800 units of vitamin D daily, and after complete healing takes place, one must ensure against relapse by adminis-tering the daily optimal dose of vitamin D to the child."

Historical background and past knowledge: Rickets was described in the first century AD by the Greek physician Soranus. Hans Burgkmair's painting of a rachitic infant in 1509, and findings of rickets in the skeleton of a child of the powerful Medici family in 16th century Italy suggest that it existed through the centuries, more so in frail children who were confined indoors [3]. It was nicknamed the 'English disease' as it was widespread in the smog covered towns of 16th and 17th century Britain. Daniel Whistler first defined it as a specific medical condition in 1645, and Francis Glisson described it in detail in 1650 [3]. Rickets was rampant in Europe during World War 1. In 1919, Edward Mellan showed that cod liver oil was therapeutic. German pediatrician Kurt Huldschinsky demonstrated cure of rickets by skin exposure to ultraviolet (UV) rays, followed by US physician Harry Steenbock's discovery that UV-radiated foods, especially milk, also cured rickets; which made it possible to almost eliminate it by mid 20th century through food fortification and food supplementation. The surmounting of this public health problem was a triumph of science and public policy. It was therefore disconcerting that within a couple of decades, rickets made a sharp comeback, as a result of cultural, environmental and political factors [4].

In areas with poor sun exposure, the effect of vitamin D repletion, whether via cod liver oil or by exposure to sunshine or UV radiation, was dramatic. Then why did children in many rural areas of developing countries, with considerable sun exposure, develop rickets? Studies from

South Africa, Nigeria, India and Bangladesh showed this was because of calcium deficiency, the poor dietary calcium content exacerbated by high dietary phytates interfering with calcium absorption [5,6]. It became clear that good musculoskeletal health required both calcium and vitamin D.

THE PRESENT

Why are VDD and rickets so rampant, especially in sunny regions like South Asia and the Middle East, and among migrant populations? We fail to realize how 'anti-D' we are becoming – dwindling time spent outdoors; increasing use of covering clothing; increasing sun screen usage; increasing pollution even in rural areas; beverages replacing milk intake – all exacerbating pre-existing problems like darker skin pigmentation, little or no food fortification, poor intake of calcium- and protein-rich foods, and interference of calcium absorption by dietary phytates. The resultant poor musculoskeletal health, causing morbidity and even mortality, impacts the entire life cycle, with a vitamin D-deficient mother having a deficient newborn, who has poor bone mass accrual across childhood and adolescence, worsened by pregnancy for women, and osteoporosis in old age. On the other hand, the near-disappearance of rickets due to Britain's wartime nutrition strategy, and voluntary vitamin D fortification of foods in the US, made it clear that public health measures can be very successful. In India, recent vitamin D fortification of packaged milk, and sin taxes on sweetened beverages, are baby steps in this direction.

Clinically diagnosed rickets is the tip of the iceberg, detected only in the most severe cases. Once we knew VDD causes rickets, early detection became possible, for which defining reference ranges for vitamin D became important. As VDD is widespread, for reasons so elegantly spelled out 50 years ago, deriving this by testing a large group of 'normal' people is untenable. Historical data cannot be used for vitamin D because assay type and quality have improved vastly. Therefore, deficiency is defined as the level of 25OHD3 below which a corrective PTH response is seen [7]. On this basis, all agree that for defining VDD, only 25OHD3 is useful; that other D metabolites are useful only in specific disease conditions; and that 25OHD3 <10-12 ng/mL constitutes deficiency. The Institute of Medicine (IOM) recommends that >20 ng/mL be considered sufficient, while the Endocrine Society recommends that this level be >30 ng/mL.

25OHD3 can be tested by different methods – assays have improved in the last three decades. With the huge interest in VDD, assays have also become more easily and cheaply available, but testing remains tricky, and care in interpretation is needed [7]. The vexed questions today regarding detection of VDD and monitoring treatment/supplementation are: whom to test, and how often to test, even as ease of testing is changing our attitudes.

All major Societies recommend D supplementation for pregnant women, infants, and vulnerable children and adolescents [8,9]; though doses and duration remain controversial [10]. With greater awareness of how ubiquitous VDD is, adherence to these recommendations is improving, but still woefully inadequate. Ironically, like the nutrition paradox, we now see iatrogenic toxicity as very high doses of D3, especially intramuscular depots or activated D3 (alphacalcidol, calcitriol), are prescribed unnecessarily. Guidelines now clearly recommend against such malpractices.

In summary, VDD and rickets were nearly eliminated by public health measures, and it can be done again. The medical fraternity must be aware of the changing needs – whether medical, environmental, or political – so we can best serve our patients.

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