

Scientific Advisory Committee on Nutrition

Subgroup on Maternal and Child Nutrition (SMCN)

Paper for discussion: Vitamin D deficiency in Children

Agenda item: 2

Please see attached paper for discussion.

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Vitamin D deficiency in Children

Issue

There have been some recent reports of vitamin D deficiency in the UK. This paper provides an update on the issue.

Introduction

1. Vitamin D deficiency still afflicts children world wide. While rickets is the commonest presentation, infants may also present with hypocalcaemic symptoms - usually seizures but also, occasionally, more serious manifestations such as cardiomyopathy.
2. Prolonged deficiency of vitamin D in children results in rickets, the main signs of which are skeletal deformity with bone pain and tenderness and muscle weakness. Rickets occurs during periods of bone growth when an excess of unmineralised osteod results in low mineral to bone matrix ratio. Plasma 25 hydroxy vitamin D concentrations below 8 micrograms per litre (20 nmol/l) are seen in children with rickets (COMA 1998).
3. Vitamin D deficiency which is less severe may also increase the risk of bone disorder. The clinical presentation may be similar to that of metabolic bone disorders and is often confounded by multiple nutrient deficiencies. Muscular dysfunction often accompanies vitamin D deficiency. The response to vitamin therapy in osteomalacia and rickets can be speedy and dramatic.

Sources of vitamin D

4. There are few dietary sources of vitamin D. Main sources include oily fish such as salmon and sardines and fortified margarines. Milk contains added vitamin D in the US but not in the UK. Most people in the UK obtain the majority of their vitamin D from exposure of skin to sunlight.

Groups at risk of vitamin D

5. In the UK, there are usually special factors which contribute to increasing risk of vitamin D deficiency. Infants from certain ethnic groups - south Asian and Afro-Caribbean - are at greater risk. This is primarily due to the fact that more ultraviolet sunlight is required to generate adequate vitamin D synthesis in dark skinned individuals (Holick, 2002). This can be a particular problem in northern latitudes (such as Canada, the UK and Scandinavia) where there is little ultraviolet radiation of the appropriate wavelength for many months of the year. However, reports have appeared from other countries where sunlight is plentiful. Here cultural practices (prolonged exclusive breast feeding

compounded by forms of dress that limit the skin's exposure to light) are suggested as being the main aetiological factors. Children on very restricted diets may also be at risk.

6. In the US, an assessment of women participating in the WIC programme (Special Supplemental Food Programme for Women, Infants and Children) suggested that factors that may have contributed to the increase in referrals of children with nutritional rickets included more African American women breast-feeding, fewer infants receiving vitamin D supplements and mothers and children exposed to less sunlight (Kreiter 2000).
7. However, it has also been reported that altered vitamin D metabolism may be responsible for low 25 hydroxy vitamin D concentrations in Asians (Awumey 1998). This suboptimal vitamin D status can lead to the occurrence of symptomatic vitamin D deficiency when there are increased requirements, as in early childhood, adolescence, pregnancy and lactation (Shaw and Pal 2001). This theory tallies with the findings of a study in Birmingham that also demonstrated a high prevalence of vitamin D deficiency among Asian men (Shaw and Pal 2001).

Dietary Reference Values for the UK

Reference Nutrient Intakes (RNI) for vitamin D (micrograms per day) (Department of Health 1991)

Age	Males	Females
0-6 months	8.5	8.5
7 months to 3 years	7	7
4 years to 65 years	-	-
65+ years	10	10
Pregnancy		10
Lactation, 0-4 months		10
Lactation, 4+ months		10

Dietary intakes and vitamin D status in the UK

8. The 1998 COMA report on Bone Health concluded that children aged 0-3 years, pregnant and lactating women and people aged 65 years or older, all of whom are vulnerable to vitamin D deficiency, had mean dietary intakes which were low. The contribution of supplements appears to be minimal except for infants and young children.
9. There is no RNI for 4-64 years of age as it is assumed that this group will receive enough vitamin D from exposure of their skin to sunlight. Within this group there may be individuals who are at risk of vitamin D deficiency and who require dietary vitamin D if they are to maintain adequate status, for example, where exposure to sunlight is restricted by extensive concealment clothing or if the person does not go out of doors, or if the skin is pigmented especially if their diet excludes meat and oily fish. For such people, the RNI would be 10 micrograms per day.

Infants and young children

10. The National Diet and Nutrition Survey (NDNS) of 1.5-4.5 year olds found that mean intake of vitamin D from all sources was 1.9 micrograms per day (median 1.1 micrograms). Vitamin D intakes from dietary supplements increased average intake by about half for all children. There were no significant differences between boys and girls or between age cohorts in intakes from food or from all sources. Children aged 1.5-2.5 obtained 17% of their mean vitamin D intake from “other milk and products”, which includes infant formula compared with only 2-5% for children aged 2.5-4.5. Vitamin D fortified spreads, 26% and breakfast cereals 17% were the other main food sources of vitamin D for all children.
11. Analyses of plasma 25 hydroxy vitamin D showed that mean levels were 68.1 nmol/l and there was no apparent association with age or sex. Levels were associated with field work wave – highest among children assessed between July and September and lowest among children assessed between January to March. 1% of children had plasma 25 hydroxy vitamin D below 25 nmol/l, indicating deficiency.
12. Lawson et al (1999a) reported suboptimal plasma vitamin D in 20-34% of 1.5 to 2.5 year old Asian toddlers. A significant association was found between failure to take a vitamin supplement, chapati consumption and low vitamin D values (Lawson 1999b).
13. The 1998 COMA report on Bone Health concluded that “vitamin D status, assessed from plasma 25 hydroxy vitamin D, of the majority of the population of children under 4 years appears to be satisfactory. Some minority groups of children remain at risk due to factors associated with lifestyle. The current programme of vitamin D supplementation for this section of the population should continue. Education programmes to reinforce this policy appear to be needed”.

Older children

14. The NDNS 4-18 showed that mean daily intakes of vitamin D from food sources for boys was 2.6 micrograms, significantly higher than that for girls at 2.1 micrograms (medians 2.4 and 1.9, respectively). Mean intakes increased with age. The main dietary sources of vitamin D were cereal and cereal products (37% boys and 35% girls), fat spreads (20% both sexes), meat and meat products (20% both sexes) and oily fish (7% boys and 9% girls). Supplements of vitamin D increased mean intakes from food sources by 8% for boys and 5% for girls. Supplements were predominantly taken by the younger children. In the 4 to 6 age group, supplements increased mean intakes by 19% for boys and 22% for girls.
15. Correlations between plasma vitamin D and dietary intakes of vitamin D were very weak and did not reach the level of statistical significance with any age or sex group. The NDNS 4-18 showed that mean plasma 25 hydroxy vitamin D was 62.0 nmol/l for boys and 60.6 nmol/l for girls; median levels were lower. Concentrations significantly decreased with age. 3% of boys and 2% of girls aged 11-18 had plasma vitamin D concentrations less than 12 nmol / l. The proportions below 25 nmol / l increase with age for both boys and girls from 3% for boys and 2% for girls aged 4 to 6 years to 10-16% for boys aged 11 to 18 and 10-11% for girls aged 11-18. Plasma levels were influenced by fieldwork

collection period, as for younger children. Boys aged 11 to 18 years were the most likely to have poor vitamin D status. From January to March there were 19% of boys in the age group with poor status, from April to June 15%, 6% from July to September and 10% from October to December.

Pregnant and lactating women

16. Much evidence links vitamin D deficiency in infancy to maternal vitamin D status. Fetal stores of vitamin D at birth are influenced by the mother's nutritional status, neonatal concentrations being 60-70% of maternal concentrations at birth, and inadequate fetal stores probably explain most of the children presenting with hypocalcaemic symptoms in the first six months of life.
17. The 1998 COMA report on Bone health also noted that there was no information on the vitamin D status in pregnant and lactating women, as assessed by 25 hydroxy vitamin D plasma levels. A study by Data et al (2002) among pregnant women from non European ethnic minorities living in South Wales found that 80 out of 160 women assessed had plasma levels below 8ng/ml on their first antenatal visit. The study found that fluency in English, dressing habits and religion did not appear have any influence on status but a higher proportion of women who had lived in Britain for longer than three years had subnormal vitamin D levels.

Reports of rickets among children in the UK

18. The incidence of rickets in the UK peaked at the end of the 1800s. In the 1940s margarine was fortified with vitamin D, free vitamin supplements were introduced as part of the Welfare Food Scheme (WFS), National Dried Milk was fortified and manufacturers soon followed suit by adding vitamin A and D to infant milks, rusks and cereals.
19. The sporadic incidence of rickets has continued. An unpublished review undertaken by Kings College, London in the 1990s (at the request of DH) confirmed that the problem of vitamin D deficiency and rickets, when occurring, still remained predominantly a problem in Asian populations. Clinicians contacted by the researchers were of the view that Asian rickets had decreased since its peak in the 1970s. Where rickets were identified, clinicians felt it was mainly dietary in origin ie children being fed strict vegetarian diets and prolonged breast feeding practices.
20. There have been anecdotal reports of an increasing problem in the UK in recent years. The British Paediatric Surveillance Unit reported 24 cases of rickets among children aged 0-4 years in the West Midlands (Unpublished letter to Royal college of Paediatrics and Child Health 2002). It was estimated that this prevalence would equate to 253 cases per year in the UK as a whole. In 1999, Mughal et al described six cases of florid rickets in infants aged 10 to 28 months who were referred to their general inner city pediatric unit by local GPs between 1995-1997. They subsequently reported that a further 8-10 children with florid rickets were identified at their unit each year since 1999 (Ashraf and Mughal 2002).

Prevention of deficiency

21. Many countries have attempted to prevent such problems by ensuring that vulnerable groups receive dietary supplements of vitamin D during critical periods, such as pregnancy, lactation and infancy.
22. In the UK current Government recommendations recommend that all pregnant and breast feeding women should receive 10 micrograms of vitamin D daily, while breast fed babies should receive 7 - 8.5 micrograms (280 - 340 IU) daily (it being known that bottle fed babies get an adequate supplement in their formula feeds). Vitamin drops for children under 5 years of age (included in the WFS) contain 7 micrograms of vitamin D.
23. There is concern that there may be a tendency for these recommendations to be overlooked by health professionals, as well as by the general public. The review of the WFS identified that uptake of vitamin drops in the UK is poor. The review concluded that the provision of free vitamin supplements offers a simple and potentially effective means of preventing adverse nutritional outcomes, particularly rickets. Nutritional rickets remains evident in the UK and it is likely that the prevalence would increase among high risk groups if the Scheme were withdrawn (COMA - PCMN).
24. Shaw and Pal (2002) have questioned whether relying on vitamin D supplements given to infants or vitamin D supplementation of formula feeds is inadequate to overcome the impact of maternal vitamin D deficiency. They have therefore proposed that all pregnant Asian women be supplemented with vitamin D in order to ensure that fetal stores are optimised.
25. There have been reports that the use of sunscreen could impair vitamin D status (e.g Ness 1999). However, prospective studies examining whether sunscreen contributes to vitamin D deficiency have not found that regular sunscreen users to be vitamin deficient (Sollitto 1997).
26. The length of time needed to expose skin to sunlight to ensure adequate vitamin D status is not known. However, in Cincinnati (lat 38° north; UK 50-58° north) 20 minutes a day out of doors with exposed hand and face were enough to maintain satisfactory vitamin D levels in older infants (Specker 1985).

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