Commentary

Inequities in advice on vitamin D?

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Vitamin D

Vitamin D refers to precursors of the active secosteroid hormone 1,25-dihydroxyvitamin D₃ (calcitriol). Vitamin D is available from two sources: skin exposure to ultraviolet B radiation (UV) and diet.¹ UV photolyses 7-dehydrocholesterol in the skin to pre-vitamin D₃, which then isomerizes to vitamin D₃. Vitamin D is available from some fortified foods (e.g. cereals and margarine), oily fish (e.g. salmon), eggs and vitamin supplements.¹ Relative to sun exposure, diet is a poor source of vitamin D in the UK, providing only between 80 and 120 IU/day, whereas skin UV exposure for 20 min in a light-skinned person during the summer months will produce upwards of 10 000 IU of vitamin D.¹,² However, increased skin pigmentation and factors that reduce the strength of UV reaching the Earth’s surface (e.g. winter season, high latitude, pollution and cloud cover), all contribute to reduce skin vitamin D production³ to the point that diet may become the primary source.

Vitamin D levels in the UK

Vitamin D status is most reliably determined by assay of serum 25-hydroxyvitamin D.⁷ Severe deficiency is described as having serum 25-hydroxyvitamin D concentrations of <25 nmol/l.⁷ In a recent study of over 7000 individuals in the UK, 15.5% of the population had 25-hydroxyvitamin D levels <25 nmol/l, however when stratifying the data in terms of ethnicity, 50% of non-white individuals had levels <25 nmol/l.⁸ Similarly, in a Welsh study of pregnant women from ethnic minorities, only a single patient out of 160 tested had a baseline level of 25-hydroxyvitamin D >25 nmol/l.⁹ Given the known importance of vitamin D for many stages of...
development, the high level of vitamin D deficiency in this vulnerable cohort is disturbing.\textsuperscript{10}

**Health implications of vitamin D deficiency**

Rickets in children and osteomalacia in adults are the classic manifestations of profound vitamin D deficiency.\textsuperscript{7} In support of vitamin D deficiency being a major problem in non-white individuals in the UK, studies have shown that the majority of individuals presenting with vitamin D-dependent rickets to clinics in London and Glasgow were not Caucasian.\textsuperscript{11,12}

However, a large body of evidence has accumulated to show a clear impact of vitamin D levels on susceptibility to a vast plethora of diseases, including autoimmunity, cardiovascular disease and cancer.\textsuperscript{10} No longer can vitamin D deficiency simply be viewed in terms of osteomalacia and rickets.\textsuperscript{13} Indeed, evidence from the US Third National Health and Nutrition Examination Survey (NHANES III) showed that 25-hydroxyvitamin D levels in the lowest quartile were associated with a significant 26\% increase in all-cause mortality after adjustment for potential confounders.\textsuperscript{14} Although not a universal finding,\textsuperscript{15} epidemiological studies have confirmed this association between low vitamin D and all-cause mortality in many other populations.\textsuperscript{16–22} Many of these studies attributed the increased mortality to an excess of cardiovascular disease and cancer associated with 25-hydroxyvitamin D deficiency. Support for a causal role of vitamin D deficiency in this excess mortality was supplied by a meta-analysis of vitamin D supplementation trials, in which even a relatively low mean dose of vitamin D (528 international units) was associated with a significant decrease in all-cause mortality (relative risk 0.93; 95\% confidence interval 0.87–0.99).\textsuperscript{23} However, interventional trials will be needed before definitive conclusions can be drawn from these observational studies. There have been some attempts to translate the risks associated with hypovitaminosis D into financial implications. Estimates of the costs associated with avoidable morbidity and mortality from low levels of vitamin D in the UK are in the order of £24 billion.\textsuperscript{24,25}

**Racial disparities in health**

There are clear health disparities between races, and nothing as clear as those that exist between African Americans and white Americans.\textsuperscript{26} The all-cause mortality rate for African Americans in 2006 was 26\% higher than for non-Hispanic white Americans.\textsuperscript{26} African Americans have a population mean serum 25-hydroxyvitamin D level of 40 nmol/l, whereas white Americans have a level of 65 nmol/l.\textsuperscript{26} From preliminary meta-analyses of serum vitamin D level-disease outcome from observational studies, differences in serum vitamin D level between African Americans and white Americans may explain many of the health disparities, although there are clearly limitations about conclusions drawn from this sort of comparative analysis.\textsuperscript{26} Efforts have been made to assess the contribution of hypovitaminosis D to racial disparities in health in the NHANES III cohort. Black race is associated with much elevated risk of death from colon cancer but adjusting for vitamin D levels attenuates this effect by 40\%.\textsuperscript{27} Astonishingly, after adjustment for vitamin D levels and income, the excess cardiovascular mortality risk associated with being black was completely abrogated.\textsuperscript{28} Clearly, these findings will need to be replicated in other cohorts, since there is the possibility of confounding variables, and also the potential that heavily pigmented individuals are able to compensate for low serum vitamin D in at least some measures of health,\textsuperscript{29,30} but these data are eloquent in conveying the potential importance of vitamin D supplementation in this ethnic group.

**Conclusions**

Selective pressure has been exerted on the vitamin D signalling pathway during humanity’s migration out of Africa.\textsuperscript{31} Modern transport links have enabled individuals of different ethnicities to accomplish in hours journeys which took the human race thousands of years to make. This has resulted in individuals being presented with levels of vitamin D biosynthesis for which evolution has never prepared them. The UK guidelines for vitamin D appear grossly inadequate. To omit reference to individuals with black skin from the vitamin D guidelines is prejudicial to their interests. It may result in an epidemic of vitamin D deficiency in this particular section of society with the attendant morbidity, mortality and healthcare costs that we have highlighted above, potentially avoidable by simple dietary supplementation. We believe that the UK government and its agencies should modify their recommendations to bring them more in line with those in the USA and acknowledge that the healthcare needs of its gloriously diverse background of citizens may be different.

Conflict of interest: None declared.
References