Vitamin D in Brisbane Office Workers

Lan H Vu, Jolieke C van der Pols, David C Whiteman, Michael G Kimlin[1], Rachel E Neale

Queensland Institute of Medical Research, Brisbane, Australia

Abstract. Vitamin D is necessary to maintain healthy bones, and may play a role in prevention of other chronic diseases such as cardiovascular disease and cancer. The main source of vitamin D is exposure to solar ultraviolet radiation. Individual vitamin D status is generally determined by measuring the serum 25-hydroxyvitamin D (25(OH)D) level. There is limited information about vitamin D levels in the Australian population. We therefore measured serum 25(OH)D levels in a group of office-workers in Brisbane. At the end of summer the mean 25(OH)D of 129 participants was approximately 74 nmol/L, and 14% of participants had insufficient vitamin D levels (using a cutoff at 50 nmol/L). At the end of winter the mean 25(OH)D of 175 participants was 54 nmol/L and 51% of people were vitamin D insufficient. Time outdoors out of peak UV times was associated with serum 25(OH)D in summer, while higher vitamin D intake was associated with higher winter serum 25(OH)D levels.

Introduction

Vitamin D, also known as the 'sunshine vitamin', is generally acquired in human skin through exposure to solar ultraviolet (UV) radiation. Adequate vitamin D levels are essential for maintenance of bone health, but there has been increasing research in the past decade into other possible benefits of vitamin D.

Individual vitamin D status is generally determined by measuring the serum 25-hydroxyvitamin D (25(OH)D) level. There is some debate about the optimal vitamin D level for health. Currently 25(OH)D less than 25 nmol/L is considered to be deficient, and less than 50 nmol/L as insufficient. However it has been suggested that 75nmol/L, or even 100 nmol/L should be the target level in human populations.

Notwithstanding uncertainty about the appropriate vitamin D level, many studies have shown that vitamin D deficiency is prevalent worldwide, particularly during winter. In Australia, low vitamin D levels have been reported in various population subgroups, including people in residential care, recently arrived migrants, and Muslim women. Suboptimal vitamin D levels have also been documented among free-living adults living in environments with high solar UV radiation levels. A broad array of factors has been shown to influence individual vitamin D levels, including both environmental and personal characteristics and behaviours, but these are likely to vary depending on the population under study.

There is a paucity of information about vitamin D levels in people who work mainly indoors and who are presumably at risk of vitamin D deficiency due to limited opportunity for exposure to solar UV radiation. We therefore conducted this study aiming to ascertain the vitamin D status in summer and winter of indoor office workers and to examine factors that independently affect vitamin D levels of this population. This knowledge is necessary for the development of appropriate public health recommendations for this subpopulation.

Methods

Brisbane-based employees of Suncorp (a large banking and insurance organisation) were invited to participate in an online survey in which sun exposure and sun protection and knowledge and attitudes about vitamin D were ascertained. A subgroup of survey participants were invited to participate in a second phase of this study in which vitamin D levels were measured. The response rate for the survey was approximately 70%. 50% of those selected to participate in the blood collection phase of the study agreed to participate, but for logistic reasons we only collected blood from 60% of these. 129 participants took part in the summer blood collection, 175 in the winter collection and 91 in both.

We asked participants to complete a questionnaire in which they recorded their time outdoors during the day, their sun protection behaviour and their vitamin D intake from food and supplements over the past month.

Serum 25(OH)D was measured using a Diasorin Liaison platform. The instrument was calibrated based on two calibration points (in triplicates) at 10 and 187.5 nmol/L. Samples from the Vitamin D External Quality Assurance Scheme (DEQAS) were measured prior to analysis and the results were on average within ±5% of the DEQAS values

We used simple descriptive statistics to describe the distribution of vitamin D. We dichotomized 25(OH)D using 75 nmol/L as the cutpoint for summer and 50 nmol/L as the winter cutpoint to allow for differences in the distribution by season and ensure adequate statistical power. Prevalence ratios (PR) were calculated to quantify associations with vitamin D insufficiency using log-binomial modeling in generalized linear models. To assess determinants of change in vitamin D levels from summer to winter, we used an ANCOVA model with the inclusion of baseline vitamin D level to adjust for the effect of regression to the mean (RTM).

Results

Serum 25(OH)D levels ranged from 33 to 129 nmol/L in summer (mean 74 nmol/L) and 14 to 94 nmol/L in winter (mean 54 nmol/L). In summer, 14% of participants had a serum 25(OH)D level of less than 50 nmol/L while in winter 51% were insufficient using this cut-off (figure 1). Had a cut-off of 75 nmol/L been used, 54% of participants would have been considered insufficient at the end of summer and 87% at the end of winter (figure 1).

There was a high correlation between summer and winter 25(OH)D levels (Pearson correlation coefficient 0.74) (figure 2)

[1] Queensland University of Technology

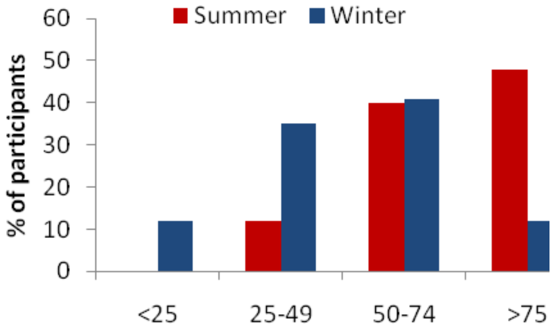

Figure 1: Distribution of participants according to serum 25(OH)D category

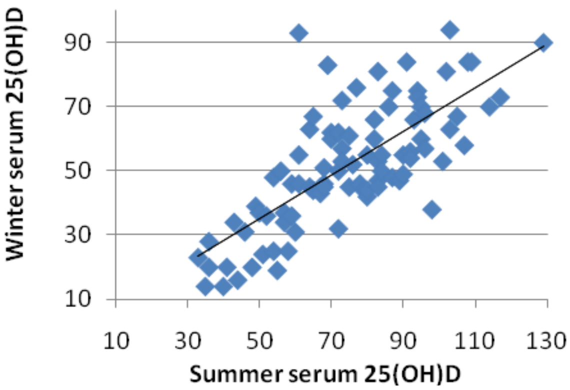

Figure 2: Correlation between summer and winter serum 25(OH)D levels

Women had a significantly lower mean serum 25(OH)D in summer than men (68.1 versus 79.4 nmol/L, $p<0.01$), and were approximately 60% more likely to have a serum concentration of less than 75nmol/L (PR 1.61 95%CI 1.15-2.26, adjusted for age). This trend was also observed in winter, although it was not statistically significant. Compared with people who had no skin cancer history, those with a history of non-melanoma skin cancer appeared to have a lower risk of having insufficient vitamin D levels in summer (PR 0.72 95%CI 0.52-1.00 using a cut-off of 75nmol/L) and in winter (PR 0.58 95%CI 0.39-0.85 using a cut-off of 50nmol/L in) in comparison with those without this history.

In summer, spending one hour or more hour outdoors per day before 9am or after 3pm at the weekend was significantly associated with increased 25(OH)D concentrations compared to sun exposure of less than 1 hour per day at these times (77.4 versus 65.7 nmol/L, p 0.004). Having sunbathed to deliberately obtain a tan in the past 12 months was also associated with increased serum levels in summer; those who had not sunbathed were at more than twice the risk of having serum 25(OH)D less than 75nmol/L. Although not significant, people who spent less than one hour outside each day on weekend days before 9am or after 3pm were more likely to be vitamin D insufficient than those who spent more time than this outside (PR 1.31, 95% CI 0.92-1.86).

There were significant differences in serum 25(OH)D concentrations according to the type of clothing worn, particularly in winter. People who often wore full-length clothes (long-sleeved, full-leg) during non-work days in winter had approximately a 50% increased risk of having 25(OH)D less than 50nmol/L compared to those who wore shorter-length clothes (short-sleeved/ sleeveless, half-leg). No significant difference in 25(OH)D was found between those who used and did not use sunscreen. Diet was associated with 25(OH)D concentrations only in winter, with those who obtained less than 10 µg of vitamin D from foods and supplements per day being at higher risk of vitamin D insufficiency (PR 1.53 95%CI 1.03-2.27).

The mean change in vitamin D levels from summer to winter was 22.8 nmol/L (95%CI 19.8-25.8). More than one third of those with sufficient summer 25(OH)D (≥50nmol/L) became insufficient in winter (35%) and 4 people (5%) became deficient (<25nmol/L). After adjusting for the regression to the mean effect in an ANCOVA model, significant predictors of change in serum 25(OH)D between summer and winter included winter vitamin D intake and smoking status .Compared to those with winter vitamin D intake less than 10µg/day, those who consumed 10µg/day or more had a 8.43nmol/L smaller change in 25(OH)D concentrations over the summer to winter period (17.74 versus 26.17 nmol/L, p= 0.002). People who never smoked had a 6.08 nmol/L smaller change in 25(OH)D than those who were past or current smokers (18.91 versus 24.99 nmol/L, p=0.02). The model could explain 31% of the variation in the change of serum 25(OH)D concentrations over this summer-winter period (adjusted R^2 0.306).

Discussion

These data show a relatively high prevalence of vitamin D insufficiency in this population of office-workers living in a subtropical climate. Given that Approximately 40% of participants had 25(OH)D levels between 50 and 75 nmol/L, the cutoff used to define insufficiency will play a major role in determining what proportion of the population is considered to be insufficient. However even using the current cutoff of 50nmol/L, over 40% of people were vitamin D insufficient at the end of winter.

Current recommendations suggest that for most people incidental sun exposure is sufficient to maintain vitamin D levels all year in Queensland. Our data suggest that this may not be the case for this population group. However we found that vitamin D intake was associated with winter serum 25(OH)D levels, and that higher intake resulted in a smaller change from summer to winter. Until more information is available about the relation between sun exposure and vitamin D production at different times of the year and in people with different skin types, winter vitamin D supplementation might be an appropriate strategy to ensure optimal vitamin D levels are maintained in indoor workers.