

Vitamin D and mental wellbeing

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Background

Recently, there has been increased interest in the vitamin D status of New Zealanders and the potential role of vitamin D in mental health and wellbeing. Vitamin D receptors are present in numerous different types of cells, including neurons and glial cells (Eyles, Smith, Kinobe, Hewison, & McGrath, 2005). Sun exposure is the major source of vitamin D for humans, and thus, in absence of supplementation or suitable fortification, the level of circulating serum 25(OH)D₃, the main marker for vitamin D status, decreases significantly during winter. Low levels of circulating serum 25(OH)D₃ have been associated with suboptimal psychological wellbeing. We investigated the association of 25(OH)D₃ and depression in a young adult sample, as well as the relationship between 25(OH)D and time spent outdoors during daylight hours.

Method

Participants

615 students (234 men, 37.5%, mean age 19 years, range 17-25y.) at the University of Otago (Dunedin, New Zealand, S45°52') participated in the Daily Life Study, a micro-longitudinal study of student experiences, during autumn of the 2011 and 2012 academic years (March-May). Analyses exclude participants who took vitamin D containing supplements (n=12).

Procedure

Participants completed an initial computerised survey including questions on demographics, personality, and wellbeing. The questionnaires included the Centre for Epidemiologic Studies Depression Scale (CES-D) (Radloff, 1977). Ambulatory assessment of time spent outside was conducted using a 2-week protocol where participants reported on their time spent outside each day through an online daily diary. Following the completion of the 2-week daily protocol, participants attended a clinic visit in the Department of Human Nutrition. Weight and height were measured using standardised techniques; and skin colour was quantified.

Measures

Demographics – age, gender, and self-reported ethnicity. Depression symptomatology - assessed using the Center for Epidemiologic Studies Depression Scale (CES-D) that has been developed specifically for research in the general population (i.e., not clinical evaluation) and scores range from 0 to 60 (Radloff, 1977).

Time spent outdoors during daylight hours – we used the sun habits question developed by Glanz and colleagues (Glanz et al., 2008) modified for close-to-real-time reporting of actual daily sun exposure in the daily diary. Height and weight – measured during the clinic visit using standardized techniques.

Skin colour – measured using a portable spectrophotometer (Konica Minolta) during clinic visit

Analyses

Serum 25(OH)D₃ was analysed using isotope-dilution liquid chromatography tandem mass spectrophotometry (Maunsell, Wright, & Rainbow, 2005). Multivariate linear regression was used to examine associations between serum 25(OH)D₃ level and depression scores adjusted for other predictors including time spent outside during daylight hours.

Results

Mean 25(OH)D₃ was 63.9 nmol/L (SD=26.5 nmol/L, range 8.2-177.0 nmol/L), and women had higher 25(OH)D₃ than men ($p<0.001$) although they spent less mean time outdoors. The CES-D scores in our sample ranged from 0 to 46 (Mean=14.1, SD=8.4).

The mean score for the time spent outside was not a good predictor of 25(OH)D₃, but the frequency of having spent 15 minutes or more outdoors per day was significantly positively associated with 25(OH)D₃ level. Each additional day during the study period that participants spent 15 minutes or more outside was associated with an increase of 2nmol/L in 25(OH)D₃ on average. Only 28.6% of participants spent 15 minutes or more outside everyday they completed a daily survey (Figure 1.).

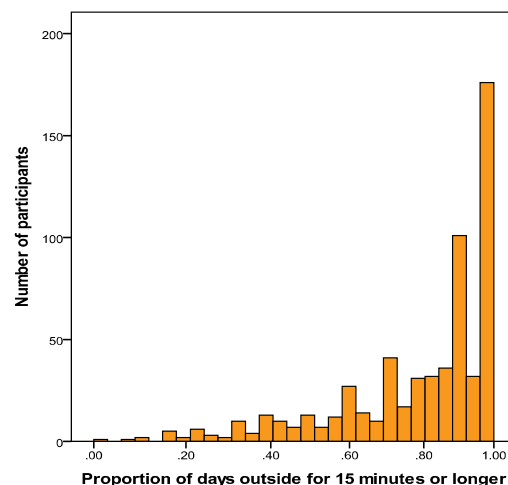


Figure 1. The proportion of days when participants spent 15 minutes or more outside during daylight hours.

25(OH)D₃ was a significant predictor of depression symptoms even after controlling for other predictors including time spent outdoors. Every SD increase in serum 25(OH)D₃ was associated with a 4.5-point decrease in the CES-D score on average (Figure 2).

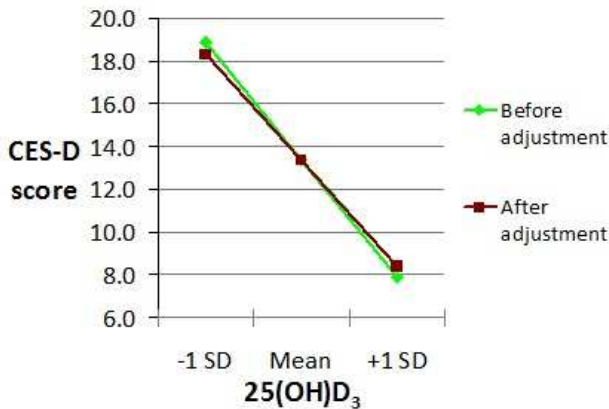


Figure 2. Relationship between 25(OH)D₃ and CES-D scores.

Discussion

We found that 25(OH)D₃ was strongly negatively associated with the presence of depression symptoms in this young adult community sample.

Measuring the participants' time spent outdoors can be a challenge, as it may be difficult to provide an accurate estimation, especially retrospectively. For this reason, we have used a daily diary experience sampling methods to capture close-to-real time experiences of our participants. Recalling time spent outdoors for the current day may be a much better estimate than averaging across days or weeks. This daily diary approach has several advantages over standard approaches, which typically involve longer term retrospective assessments of behaviour. Foremost, this approach measures actual experience rather than recalled events and has been shown to provide a better indication of true behavioural patterns by limiting recall bias and minimizing belief-based reconstruction (Tugade, Conner, & Feldman Barrett, 2007). Even though participants reported on time spent outdoors daily, we did not have information about the time of day when participants went outside or the weather conditions at exposure time, such as cloud cover. Since vitamin D is manufactured in the skin in response to sun exposure, the amount of skin exposed to the sun without protection may have been different for individual participants, with additional variations by day. Moreover, a plateau of vitamin D production is reached after about 30 minutes of sun exposure (Holick, 1995), suggesting that additional time outdoors may not provide additional benefits as far as vitamin D production is concerned. This is the most likely reason for the frequency of spending 15 minutes or more per day being a predictor of 25(OH)D₃, but not the mean sun exposure score.

We found that serum 25(OH)D₃ level was inversely associated with, and may be an independent predictor of depression. These results suggest that vitamin D may be an important protective factor against depression, even though there are many other variables that play a role in the aetiology and course of depression. Frequencies of light along the electromagnetic spectrum other than the UV bands have the potential to influence mood/depression, but only UVB has the potential to significantly influence serum vitamin D₃ levels. However, UVB also has a role in skin cancer causation. The relationship between exposure to sunlight which includes a broad range of light frequencies,

among them visible light, and 25(OH)D₃ levels and psychological wellbeing are not necessarily straightforward. In a free living population it would be challenging to control for the exposure to particular light frequencies. Importantly, however 25(OH)D₃ level seems to be modifiable through the increased frequency rather than the mean overall duration of sun exposure.

Summary

- Serum 25(OH)D₃ was inversely associated with depression scores in this young community sample of Otago students
- Higher frequency of spending 15 or more minutes per day outdoors was associated with higher serum 25(OH)D₃

Acknowledgements

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