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SOUNDING BOARD

To Be or Not To Be Exposed to Direct Sunlight
Vitamin D Deficiency in Oman

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تتعرض أو لا تتعرض لأشعة الشمس المباشرة
نقص فيتامين (د) في عُمان

مؤنس الششتاوي

الملخص: توجد نسبة بسيطة فقط من فيتامين (د) من مصادر غذائية، في حين يتم تصنيع غالبية كمية الفيتامين في الجلد بواسطة الأشعة فوق البنفسجية (باء) من أشعة الشمس، هذا إذا ما تعرض الشخص بما فيه الكفاية لأشعتها المباشرة. تم إثبات نقص فيتامين (د) في سلطنة عُمان. كشف "المسح الوطني العُماني عن المغذيات الدقيقة الذي أجري في عام 2004"، ودراسات أخرى حديثة أن مخازن فيتامين (د3) منخفضة عند النساء العمانيات السليمات في عمر الإنجاب والنساء الحوامل. إن هذا الوضع مربك تماما، فكما هو معروف أن عُمان تُعد من أكثر البلدان في العالم التي تسطع فيها الشمس بوفرة، لكن في الوقت نفسه من المعروف جيدا أن معظم النساء العُمانيات يغطين غالبية أجسادهن ويتجنبن التعرض لأشعة الشمس لأسباب مختلفة. وتبرز المقالة سؤالا حول التوازن الذي ينبغي الحفاظ عليه بين التعرض لأشعة الشمس المفرطة التي تؤدي إلى زيادة خطر الإصابة بسرطان الجلد، والتعرض الصحي الذي يوفر الأشعة فوق البنفسجية بجرعات وافية للحفاظ على مخزون كاف من فيتامين (د). من أجل تجنب نقص فيتامين (د)، يجب أن يتم برمجة رسائل التعرض لأشعة الشمس أو الوقاية منها وفقا للحالات المختلفة، مع الاعتراف بالمزيج المعقد من العوامل الشخصية والثقافية والاجتماعية التي تؤثر على إنتاج فيتامين (د) في الجلد.

مفتاح الكلمات: نقص فيتامين (د)، 25–هيدروكسي فيتامين (د) ، أشعة الشمس، الأشعة فوق البنفسجية، سرطان الجلد، سلطنة عُمان.

Abstract: Only small amounts of vitamin D come from dietary sources as it is mainly synthesised in the skin from the ultraviolet B (UVB) fraction of sunlight if the person is sufficiently exposed to direct sunlight. Vitamin D deficiency has been well documented in Oman. The "2004 Oman National Micronutrients Survey" and other recent studies revealed that vitamin D3 stores are low among healthy Omani females of childbearing age and pregnant women. This situation is confusing as Oman is known to be one of the sunniest countries in the world. However, it is known that most Omani women are well covered and for various reasons avoid sun exposure. The article addresses a question about the balance that should be maintained between excessive sun exposure that leads to an increased risk of skin cancer, and healthy exposure that provides sufficient ultraviolet radiation (UVR) to maintain adequate vitamin D levels. In order to avoid vitamin D deficiency, sun exposure or protection messages must be tailored according to different situations, in recognition of the complex combination of personal, cultural and social factors that affect vitamin D synthesis in the skin.

Keywords: Vitamin D deficiency, 25-hydroxyvitamin D, Sunlight, Ultraviolet Rays, Skin Cancer, Oman

Only a small amount of vitamin D comes from dietary sources, e.g. fish and meat,[1] while most of it is known to be made by the body as a natural by-product of the skin's exposure to sunlight.[2] In the early 1900s, the discovery of the link between rickets and vitamin D deficiency helped to ensure that exposure to the ultraviolet B (UVB) fraction of sunlight became popular as a preventative medical intervention.[3]

UVB rays enter the epidermis and release energy that changes a pre-existing cholesterol metabolite to previtamin D3, which is then slowly converted nonenzymatically to vitamin D3 (cholecalciferol). Vitamin D3, bound to a specific vitamin D-binding protein (DBP), is then transported to the liver, where it is enzymatically hydroxylated to 25-hydroxyvitamin D (calcifidiol or 25(OH)D). Although 25(OH)D is only weakly biologically active, its circulating level furnishes a good index of the bioavailability of vitamin D because it has a long serum half-life (2 weeks).[4] Then, 25(OH)D, bound to DBP, is transported to the kidney and other organs, where it is hydroxylated at the 1 position to produce 1,25(OH)2D, the most biologically active form of vitamin D.[4]

From our point of view, sun education started to emphasise the importance of protection from harmful ultraviolet rays (UVR), especially after

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the strong involvement of the United Nations (UN) in work to understand the health effects of UVR exposure. This was established at the UN Conference on Environment and Development in 1992. The trigger for that was the recognition that the ozone layer was being depleted and that the risk of diseases resulting from excessive exposure to UVR, particularly skin cancers, would probably increase.[5]

Several studies have demonstrated that exposure to environmental levels of UVR alters the activity and distribution of some of the cells responsible for triggering immune responses in humans. Consequently, sun exposure may enhance the risk of infection with viral, bacterial, parasitic or fungal infections, which has been demonstrated in a variety of animal models.[6] The known health effects of UVR include also photokeratitis and photoconjunctivitis. Moreover, sun exposure, in particular exposure to UVB, appears to be a major risk factor for cataract development.[7] Regarding skin, exposure to UVR is considered to be a major aetiological factor for its three common forms: basal cell carcinoma (BCC), squamous cell carcinoma (SCC) and malignant melanoma (MM). Non-melanoma skin cancers, BCC and SCC, are most frequent on parts of the body that are commonly exposed to the sun such as ears, face, neck and forearms. This implies that long-term, repeated UVR exposure is a major causative factor. Moreover, there is a clear relationship, in some countries, between an increasing incidence of non-melanoma skin cancers and decreasing latitude, i.e. higher UVR levels.[6] On the other hand, the causes of malignant melanoma (MM) are not fully understood. However, several epidemiological studies support a positive association with a history of sunburn, particularly sunburn at an early age. Tumour development may be linked to high, intermittent exposure to solar UVR,[6] such as at weekends or on holiday.[7] The higher incidence of malignant melanoma in indoor workers compared to outdoor workers supports that notion.[7] Studies show also that malignant melanoma risk is higher in people with a history of non-melanoma skin cancers and of solar keratoses, both of which are indicators of cumulative UV exposure.[6]

In assessing how much sun exposure is needed for adequate vitamin D production, one should be aware that there is a threshold level of UVB required to induce vitamin D production.[8] However, the exact dose of UVR exposure for optimal vitamin D levels is not known, particularly as the required UVR dose will be influenced by host factors. Whole body exposure in a bathing suit to one minimum erythemal dose (MED) of UVR is equivalent to ingesting 10,000 international units of vitamin D.[9] MED is defined as the UVR exposure that will produce a just perceptible erythema 8–24 hours after irradiation of the skin. The MED is specific to each individual and varies with the source of UVR, the tanning capacity and any adaptation from previous exposures.[10]

A low level of casual sun exposure, even during summer, will result in only very small amounts of endogenous vitamin D3 production.[11] The effects of sunlight exposure on vitamin D3 synthesis are also decreased by the use of sunscreens and in individuals with darker skin pigmentation[12] because of the presence of high concentrations of melanin in the stratum corneum that severely inhibits vitamin D3 production.[10] In addition to that, concentrations of 25(OH)D in blood serum—the best clinical index of vitamin D status—decline with age due to declining intake, decreased sun exposure and, perhaps most importantly, less efficient skin synthesis of vitamin D3.[13] Thus, for a person with moderately fair skin, exposure of face, hands and arms for 6–7 minutes at 10:00 or 14:00 in summer (or 9–12 minutes in winter) in northern Australia (latitude 17° south), should produce around 1,000 IU of vitamin D, an amount sufficient to maintain vitamin D concentrations in the normal range. The equivalent exposure required at a higher latitude such as Tasmania (41–43° south) is 7–9 minutes in summer, but 40–47 minutes in winter.[14] However, some argument remains over the range of concentrations of vitamin D in blood that should be considered 'normal'. Currently, 50 nmol/L is accepted as the lower limit of sufficiency,[5] although a study from Finland, suggested 80 nmol/L as the minimum level in blood able to prevent physiological changes associated with vitamin D insufficiency.[15]

Although a low prevalence should be expected, studies carried out in the last two decades show a high prevalence of vitamin D deficiency in many tropical countries,[16] including Oman. In 2004, the Ministry of Health (MOH), Oman, in collaboration with the Centers for Disease Control and Prevention (CDC), the World Health Organization (WHO) and the United Nations International Children's

Emergency Fund (UNICEF) conducted a cross-sectional household-based survey of micronutrient status using the sophisticated technique of high-performance liquid chromatography (HPLC) in the MOH Central Public Health Laboratory to analyse vitamin D and other micronutrients in serum samples from 832 households. The survey clusters were selected using the PPS (proportional to population size) sampling methodology.[17] A sub-sample of 298 non-pregnant women of child bearing age was analysed for serum 25(OH)D. Alarmingly 21.4% of the women included in the survey were found to be vitamin D deficient (<27.0 nmol/L).[17] Almost half of the women (47%) tested had serum 25(OH)D levels below 37.5 nmol/L, while only 10% of the women had levels above 75 nmol/L.[18]

A more recent study by Al-Kindi in 2010[16] investigated serum 25(OH)D levels among 41 apparently healthy Omani women of childbearing age. All the women had a 25(OH)D level <50 nmol/L as the cut-off for deficiency. Another study conducted by Al Kalbani et al. in 2010[19] investigated the vitamin D status of pregnant Omanis by measuring their circulating 25(OH)D levels. In that study, blood samples were obtained from a cohort of 103 consecutive healthy pregnant Omanis on their first antenatal visit to the hospital. The study revealed that vitamin D deficiency ([25(OH)D] <25 nmol/L) was present in 34 cases (33%), 'at risk' levels ([25(OH)D] = 25–50 nmol/L) were found in 67 cases (65%); two cases (1.9%) had values between 50 and 75 nmol/L, and not one case was found in the optimal range (25(OH)D >75 nmol/L). The results confirmed that vitamin D3 stores are low in Omani females of reproductive age. The findings of the study were found by Al Kalbani and her colleagues to be similar to those reported earlier in Saudi Arabia and recently in the UAE and Qatar.[20,21,22]

These recent studies conducted in Oman give a warning that subclinical vitamin D deficiency may be prevalent amongst Omani women and indicate the need for vitamin D replacement especially during pregnancy and lactation.[16,19] This situation is surprising as Oman is known to be one of the sunniest countries in the world and its people are thus expected to have adequate sun exposure. This unexpected situation may be attributed to social and cultural factors[16] as the conservative dress of Omani women, especially those who wear the veil, blocks exposure to sunlight. Added to that, the reduction in outdoor leisure time that has accompanied urbanisation in Oman and the rise in office-based work has lead to an increased lack of sunlight exposure. Females, particularly those who are sensitive to the sun's UV rays, are more concerned about their appearance and health. They are unwilling to get dark-coloured skin or sunburn, and so avoid being exposed directly or indirectly to sunlight.

So, the boundaries between the risks and the benefits of UVR are unclear and the question therefore arises: "What is the balance between healthy sun exposure that provides sufficient UVR to maintain adequate vitamin D levels in blood serum, and excessive exposure that leads to an increased risk of skin cancer?" Unfortunately, public health campaigns aiming to decrease the incidence of skin cancer urged people to limit exposure to ultraviolet light, which is important for maintenance of vitamin D levels, especially in at-risk groups such as those who are elderly, who suffer from malabsorption or who have dark skin (particularly if they wear a veil).[23] It is important also to mention that the guidelines for decreasing exposure included directives from the American Academy of Pediatrics (AAP) that infants younger than 6 months should be kept out of direct sunlight, children's activities that minimise sunlight exposure should be selected, and protective clothing as well as sunscreens should be used.[24] Accordingly, one consequence of avoiding possibly harmful sun exposure could be a reduced amount of physical activity, especially when school, work and rec-reational activities are usually scheduled outdoors between 10:00 and 16:00. Sun protection messages may, thus, inadvertently increase health risks related to physical inactivity such as obesity and cardiovascular disease.[23]

All these irritatingly contradictory relationships make it very difficult to determine what the adequate sunshine exposure time is for any given person. The message to protect against excessive UVR exposure was seen to be correct in countries with abundant sunshine and populated by fair-skinned inhabitants. Even for populations that remain in the physical environments for which they are evolutionarily suited, marked changes in the social environment now predispose people to diseases associated with under- or over-exposure to UVR. Similarly, in populations that have moved from their traditional habitats, problems of both excess sun exposure and vitamin D insufficiency are clearly evident.[5]

The first national cancer council to recognise the importance of balance in recommendations about sun exposure was the Cancer Council Australia in its 2005 position statement "Risks and benefits of sun exposure".[23] The statement did provide sufficient guidance on optimum levels of exposure.[5] However, the correct answers to several questions are still under debate: "What is the optimal level of vitamin D?", "What is the amount of UVR needed to maintain an adequate vitamin D level?", and "What is the optimal age-appropriate UVR dose?"

The conclusion is that increased UVR exposure is known to have harmful health consequences; however, UVR exposure also has some beneficial effects, especially in relation to vitamin D production. Therefore, a 'one message fits all' approach is not appropriate. Sun exposure or protection messages may need to be shaped to different situations, in recognition of the complex combination of host factors, e.g. age, sex, race, skin pigmentation, and sun-seeking or sun-avoidance practices. This matrix of considerations becomes even more complex when a diversity of cultural and social environments are taken into account. Added to that, the lack of clear guidelines may lead to inappropriate personal solar exposure. The substantial challenge for health workers is to translate their knowledge into readily comprehensible public health messages and, subsequently, to take account of the accretion of upcoming evidence-based information.

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