

Original Article

Suburban clustering of vitamin D deficiency in Melbourne, Australia

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Objective: A high prevalence of mild to moderate vitamin D deficiency has been observed in women who have recently arrived from the horn of Africa and living in inner Melbourne. Vitamin D status of women with differing age and ethnic distributions residing in other suburbs is unknown. **Method:** A tertiary referral Women's hospital-based survey of serum 25(OH)D concentrations in 2,690 women aged 14-78 years residing in Melbourne between 1 July 2004 and 30 June 2005. We computed odds of serum 25(OH)D concentrations < 50 nmol/L and used tests of homogeneity across different suburbs in Melbourne, Victoria. **Results:** Women with moderate vitamin D deficiency from all suburbs were young [29.1 ± 7.2 years (mean \pm standard deviation)]. The odds of moderate vitamin D deficiency were highest in inner suburbs and Greenvale, Coburg, Pascoe Vale South, Fawkner, Broadmeadows and Campbellfield from the Hume-Moreland municipality (p value for homogeneity of odds < 0.001). **Conclusion:** Vitamin D deficiency appears to be a growing health concern in Australia and may be more prevalent in younger women in Victoria than anticipated.

Key Words: vitamin D, ethnicity, young women

INTRODUCTION

The public health implications of vitamin D deficiency in Australia have received a great deal of attention with a recent editorial¹ and position statement² and the Vitamin D and Calcium Forum held in Melbourne in July 2005. Adverse effects of vitamin D deficiency have been implicated in the development of bone disorders. Mild (serum 25 (OH)D between 25-49nmol/L) to moderate (serum 25 (OH)D between 12.5-24nmol/L) vitamin D deficiency may induce high bone turnover and bone loss. In addition, moderate deficiency may increase the risk of hip fractures in elderly populations.³ Although thought to be rare in Australia, severe vitamin D deficiency (serum 25 (OH)D < 12.5nmol) leads to osteomalacia.⁴ Moreover, vitamin D deficiency in the elderly in residential care is a reversible cause of falls.^{5,6}

In Australia, significant degrees of vitamin D deficiency are prevalent particularly amongst the elderly in residential care and in recent arrivals from the African continent.^{7,8} Vitamin D deficiency is also common in Muslim women who veil themselves.⁹ The combination of dark skin and veiling probably causes additive risk of vitamin D deficiency. As veiled women cover most of their body including arms and legs, the skin virtually has no direct contact with sunlight.

Although an increase in diagnosed cases of mild to moderate vitamin D deficiency has been observed in persons residing in inner Melbourne due to the recent large number of new arrivals from the horn of Africa,⁸ levels of vitamin D in other suburbs of Melbourne with varying ethnic populations have not been reported. Low levels of vitamin D and age distributions of women residing in other suburbs may suggest a higher prevalence among low risk populations.

METHODS AND SETTING

We identified all patients who had their serum 25-hydroxyvitamin D (25-(OH)D) levels measured, among females aged 14 to 78 years attending the Royal Women's Hospital, between 30 June 2004 and 1 July 2005. Serum 25-(OH)D concentrations were measured at the Royal Children's Hospital by radioimmunoassay using the Immunodiagnostic Systems assay (IDS Ltd., Boldon,

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England). Approval to use de-identified data for this study was granted by the Office for Research at Western Health as a quality assurance project.

In this study we focus on suburbs within The Moonee Valley Melbourne Primary Care Partnership and the Hume-Moreland Primary Care Partnership. The Moonee Valley Melbourne Primary Care Partnership covers the cities of Moonee Valley (www.mvcc.vic.gov.au) and Melbourne (www.melbourne.vic.gov.au) including suburbs from inner and outer north-west Melbourne. The City of Melbourne has an estimated total population of 61,670 (www.melbourne.vic.gov.au). The City of Moonee Valley is a larger municipality in the Melbourne metropolitan area, with an estimated total population of 111,553 (www.mvcc.vic.gov.au). Moonee Valley has an ageing population, with 12.7% of residents older than 65 years of age, compared to a metropolitan average of 10%.

The Hume – Moreland PCP catchment covers the cities of Hume and Moreland. The City of Hume is a large municipality with a population estimated at 157,054 (www.hume.vic.gov.au) and an age distribution greatest in adults from 25 to 49 years. The City of Moreland is located to the north of Melbourne, 5 km from the inner city, with an estimated population of 135,843 (www.moreland.vic.gov.au). The age distribution varies, with a large population of adults aged 20 to 39 and older persons over 60 years compared to metropolitan Melbourne.

All four of these municipalities are culturally diverse. In the City of Melbourne, 38% of the residents were born overseas with the most common language, other than English, spoken at home being Mandarin. In Moonee Valley, 27.8% of residents were born overseas, with Italian and Greek being the most common languages spoken at home, other than English. In the City of Hume, approximately 29% of residents were born overseas and the most common language spoken at home, other than English, is Turkish. In the City of Moreland, 33.5% of residents were born overseas with Italian and Greek being the most common languages, other than English spoken at home.

Statistical analysis

We computed the odds of serum 25(OH)D concentrations < 50 nmol for each suburb within The Moonee Valley Melbourne Primary Care Partnership and the Hume-Moreland Primary Care Partnership. We performed the chi-squared test of homogeneity of odds across suburbs for each of the partnerships. All statistical tests were two-sided with significance level chosen at 5%. All statistical analyses were performed in STATA Version 9.2 (Stata-Corp 4905 Lakeway Drive College Station, Texas 77845 USA).

RESULTS

There were 2,144 blood tests with a serum 25 (OH)D level less than 50 nmol/L among 2,690 referrals (about 80% of all referrals) in the 2004-2005 period. Among all referrals, 1,317 were in women residing the Hume-Moreland municipality and 397 were in women living in the Moonee-Valley-Melbourne municipality. Sixteen per cent (n=342) of women were from the Moonee Valley

Melbourne Primary Care Partnership catchment while 50% (n=1082) were from the Hume-Moreland Primary Care Partnership catchment, together making up the greatest proportion of women presented at the Royal Women's Hospital with serum 25 (OH)D levels below 50 nmol/L. While, approximately 34% of women with serum 25 (OH)D levels below 50 nmol/L were located in other municipalities across Melbourne (33% of women with serum 25 (OH)D levels between 25-50nmol/L, 33% of women with serum 25 (OH)D levels between 12.5-24nmol/L and 26% of women with serum 25 (OH)D less than 12.5nmol/L were from other areas not covered in the two municipalities).

Among patients with serum 25 (OH)D levels less than 50 nmol/L, women from all suburbs were young: [29.1 ± 7.2 years (mean ± standard deviation)]. The mean age of women residing in suburbs within Moonee Valley-Melbourne localities was 30.9 ± 7.46 years (mean ± standard deviation) and the mean age of women from Hume-Moreland was 28.4 ± 6.84 years. The number of older women (over 59 years of age) in both localities was low, with 4 from Moonee Valley - Melbourne and 6 from Hume-Moreland.

The distribution of serum 25 (OH)D levels below 50 nmol/L for suburbs within localities of Moonee Valley-Melbourne and Hume-Moreland are presented in Table 1. For the Moonee Valley-Melbourne municipality, the odds of serum 25(OH)D concentrations < 50 nmol/L was highest in Carlton, followed by North Melbourne, Flemington, Melbourne and Maribyrnong. In the Hume-Moreland municipality, the odds of serum 25(OH)D concentrations < 50 nmol/L was highest in women residing in Greenvale, Coburg, Pascoe Vale South, Fawkner, Broadmeadows and Campbellfield (all odds > 5 and statistically significant).

DISCUSSION

An examination of a large hospital-based survey of vitamin D in Melbourne suggests that there are substantial numbers of women with serum 25 (OH)D levels less than 50 nmol/L from a number of different suburbs in inner, outer-west and north-west localities across Melbourne.

Within inner Melbourne, a greater proportion of women with moderate vitamin D deficiency reside in Carlton, North Melbourne, Flemington and Maribyrnong. This may be explained by the recent influx of new arrivals from the African continent and who may also veil themselves. Most residents live in housing estates with very little or no access to outdoor areas with sunlight exposure. Data from the other locality, Hume-Moreland, reveal surprisingly large numbers of young women with mild to moderate vitamin D deficiency. Women in the Hume-Moreland areas predominantly live in single dwelling households with access to private outdoor space and include young women who are Australian-born and speak English as their preferred language. Women who live in Greenvale, Coburg, Pascoe Vale South, Fawkner, Broadmeadows and Campbellfield have the highest proportion of moderate vitamin D deficiency. With the exception of Coburg and Fawkner, suburbs predominant with an ageing population of Italian and Greek migrants, women from most suburbs are young, Australian-born and speak

Table 1. Serum 25 (OH)D levels less than 50 nmol/L among women referred for a blood test and residing in suburbs within Moonee Valley and Hume-Moreland in Melbourne, Victoria n=1,714

Locality	Mild (25-50nmol/L)	Moderate (12.5-24nmol/L)	Severe (<12.5nmol/L)	Total in sample	Odds [§] (95% CI)
Moonee Valley-Melbourne***					
Melbourne(3000)	9 (4.5)	2 (1.7)	0 (0.0)	13	5.5 (1.2 – 24.8)
Flemington (3031)	62 (30.7)	41 (34.8)	8 (36.3)	123	9.3 (5.1 – 16.8)
Maribyrnong(3032)	37 (18.3)	13 (11.0)	4 (18.2)	64	5.4 (2.8 – 10.6)
North Melbourne(3051)	30 (14.9)	18 (15.2)	1 (4.6)	53	12.3 (4.4 – 33.9)
Carlton(3053)	36 (17.9)	33 (27.9)	6 (27.3)	79	18.8 (6.9 – 51.3)
Other [†]	28 (13.7)	11 (9.4)	3 (13.6)	65	1.8 (1.1 – 3.0)
Total	202	118	22	397	
Hume-Moreland***					
Tullamarine(3043)	13 (1.7)	8 (2.9)	0 (0.0)	33	1.8 (0.8 – 3.6)
Pascoe Vale South(3044)	9 (1.2)	6 (2.1)	1 (6.7)	18	8.0 (1.8 – 34.8)
Glenroy(3046)	128 (16.3)	35 (12.5)	3 (20.0)	199	5.0 (3.5 – 7.3)
Broadmeadows(3047)	183 (23.3)	68 (24.2)	3 (20.0)	294	6.4 (4.5 – 8.9)
Meadow Heights(3048)	104 (13.2)	45 (16.0)	1 (6.7)	179	5.2 (3.5 – 7.7)
Atwood(3049)	16 (2.0)	7 (2.5)	0 (0.0)	35	1.9 (0.9 – 3.9)
Brunswick West(3055)	17 (2.2)	6 (2.1)	0 (0.0)	29	3.8 (1.6 – 9.4)
Brunswick(3056)	33 (4.2)	14 (4.9)	0 (0.0)	60	3.6 (1.9 – 6.7)
Coburg(3058)	55 (7.0)	32 (11.4)	2 (13.3)	100	8.1 (4.3 – 15.1)
Greenvale(3059)	12 (1.5)	2 (0.7)	0 (0.0)	15	14.0 (1.8 – 106)
Fawkner(3060)	63 (8.0)	19 (6.8)	0 (0.0)	94	6.8 (3.7 – 12.5)
Campbellfield(3061)	42 (5.3)	13 (4.6)	2 (13.3)	66	6.3 (3.1 – 12.8)
Craigeburn(3064)	95 (12.1)	21 (7.5)	2 (13.3)	154	3.3 (2.3 – 4.8)
Sunbury(3429)	11 (1.4)	1 (0.4)	0 (0.0)	25	0.9 (0.4 – 2.0)
Other [‡]	5 (0.7)	4 (1.4)	1 (6.7)	16	1.7 (0.6 – 4.6)
Total	786	281	15	1317	

n represents the number cases from the respective locality e.g., 9 of the 202 cases of mild vitamin D deficiency in the Moonee Valley-Melbourne locality reside in inner Melbourne. †: other includes women residing in postcodes 3003, 3006, 3008, 3033, 3034, 3039, 3040, 3041, 3042, 3052, 3141, 3207. ***: *p* value for homogeneity of odds < 0.001. ‡: other includes women residing in postcodes 3057, 3063, 3428. ***: *p* value for homogeneity < 0.001. §: Represents Odds of vitamin D deficiency (< 50nmol/L) for each suburb. Note: % represents column totals for each municipality.

English. Indeed, the majority of these women may be descendants of Turkish and Arabic migrants and Muslim. However, they are unlikely to wear a veil and cover their faces, arms and legs, as cultural practices have changed throughout the years.

Vitamin D deficiency in dark-skinned persons,⁸ veiled women⁹ and the elderly in nursing homes or aged care facilities^{5,10,11} has been well established. However, the status of vitamin D deficiency in young low risk women is less clear.¹² In this exploratory study of young women residing in suburbs across inner West and North Melbourne, Victoria, we found sizeable clusters of women with mild to moderate vitamin D deficiency.

Although we expected moderate to low levels of vitamin D in clusters of women located in inner Melbourne (recent arrivals from the Horn of Africa who settle in inner suburbs), we were surprised to observe moderate to low levels in other geographic distributions, particularly suburbs located in the Hume-Moreland municipalities with varying demographic and age distributions compared to inner suburbs of Melbourne. Therefore, these preliminary findings may suggest a higher prevalence of moderate to low levels of Vitamin D deficiency among low risk populations of young women. A population-based study is required to confirm these preliminary findings.

The data presented here are consistent with a study of Mediterranean women.¹³ They report increased incidence

of vitamin D deficiency in women who were non-religious and who did not dress in a particular manner. A Finnish study of 196 healthy young women with a mean age of 38 years (SD=3)¹⁴ found that 86% of these women had insufficient vitamin D levels at the end of winter even though the vitamin D intake of these women met the current recommendations. Others suggest similar findings in otherwise healthy young women.^{15,16}

A number of limitations should be considered when interpreting the data. Firstly, the sample of women is biased. Although not known, we assume that the women were tested for clinical reasons. Women may have been pregnant or may be attending other clinics such as oncology. No information on the relative proportion of samples from each clinical setting is available for comparison. Secondly, other than age, we do not have a description of other characteristics of the women such as ethnicity or language spoken at home. Without demographic and clinical information on these women no inferences from these data can be made, hence we present summary prevalence measures. Despite these potential limitations, the data presented here are nonetheless useful to generate hypotheses regarding age and ethnic distributions of women with low vitamin D levels residing in the general community.

In summary, data included in this study suggest suburban clusters of young women with mild to moderate vitamin D deficiency in Melbourne. These cases are likely

to be an underestimate, given that women attend other hospitals such as the Northern Hospital, the Mercy Hospital, Western Health and St Vincent's Health, or do not attend hospitals at all. Apart from the young women identified through the Royal Women's Hospital, young women with mild-to-moderate vitamin D deficiency may be ill-informed and unaware of the risk of vitamin D deficiency during pregnancy or to their infant during breast feeding. Consequently, this situation adds to the already growing health problem of vitamin D deficiency in infants and young children in Australia.¹⁹

Vitamin D deficiency in Australia is a growing health concern and may be more prevalent within the wider community than first thought. Studies to evaluate the health impact of vitamin D deficiency in Australia have long been overdue. To date, most Australian studies have focused on the elderly, pregnant or Muslim women and none of these have been on healthy young adults. Vitamin D deficiency has major health implications for young women, particularly during the child-bearing years. Recent data show reduced foetal growth²⁰ and reduced bone mineral accrual during childhood in the offspring of women with mild-moderate vitamin D deficiency during pregnancy²¹. Vitamin D supplementation in vitamin D-deficient pregnant women could lead to long-lasting reductions in fracture risk in their offspring.²¹ It is therefore timely to fund research into public health interventions, such as programs to facilitate ethnic groups, that focus on activities promoting an outdoor lifestyle and careful sun exposure. In addition it is very important that access to low cost, higher dose vitamin D supplementation is improved.

AUTHOR DISCLOSURES

Bircan Erbas, Peter R Ebeling, Dianne Couch and John D Wark, no conflicts of interest.

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澳洲墨爾本維生素 D 缺乏的近郊群集情況

目的：最近自非洲角移居澳大利亞墨爾本內的女性被發現有輕微至中度維生素 D 缺乏的高盛行率。居住於其他近郊不同年齡跟種族分佈之女性，其維生素 D 狀態目前是不知道的。方法：一個三級轉介婦女醫院研究，從 2004 年 7 月 1 日至 2005 年 6 月 30 日期間，調查 2690 名 14-78 歲居住於墨爾本女性的血清 25(OH)D 濃度。我們計算維多利亞州墨爾本不同郊區血清 25(OH)D 濃度小於 50 nmol/L 的勝算，並檢驗其同質性。結果：所有郊區中有中度維生素 D 缺乏的都是年輕女性【 29.1 ± 7.2 歲(平均值 \pm 標準差)】。中度維生素 D 缺乏勝算最大的是在內部郊區及 Hume-Moreland 自治市的 Greenvale, Coburg, Pascoe Vale South, Fawkner, Broadmeadows and Campbellfield(勝算同質性， p 值 < 0.001)。結論：維生素 D 缺乏的情況成為澳洲一個發展中的健康議題，維多利亞的年輕女性的狀況比預期的高。

關鍵字：維生素 D、種族淵源、年輕女性。