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High prevalence of vitamin D insufficiency and deficiency in a mixed sample of patients in Brunei Darussalam

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ABSTRACT

Introduction: Deficiency of vitamin D is linked to a number of conditions and is known to be prevalent in the South-east Asian region. The aim of the study was to assess the prevalence of vitamin D insufficiency and deficiency in a mixed sample of patients in Brunei Darussalam and to evaluate the sources of referral for vitamin D testing. **Materials and Methods:** This is a retrospective study on patient's age, sex, source of referral and vitamin D levels done in 2012 were obtained from the results maintained in the Clinical Chemistry Section of the Department of Laboratory Services. **Results:** Complete data was available on 408/446 patients. A total of 61.3% women and 37.7% men had either vitamin D insufficiency or deficiency. Women (n=331) had significantly lower mean levels of vitamin D level compared to men (n=77, 47.9 ± 21.3 nmol/L vs 60.9 ± 23.7 nmol/L; $p<0.05$). Patients under 50 years of age (n=193) had lower level of vitamin D compared to those above 50 years of age (n=215) (46.3 ± 20.1 vs 54.1 ± 23.6; $p<0.05$). The most common source of request for vitamin D level testing was the Internal Medicine unit (64.7%) followed by Rheumatology (15.7%) and Endocrinology (5.1%). **Conclusions:** More than 50% of patients tested had insufficiency or deficiency of vitamin D across various specialties. Internal medicine and related clinics were the most common sources of request. There is a need for further studies to determine the prevalence and risk factor for vitamin D insufficiency in general population and in specific disease states in Brunei Darussalam.

Keywords: Vitamin D, Vitamin D deficiency, Prevalence, Brunei Darussalam

INTRODUCTION

The most important and widely recognised role of vitamin D is in calcium homeostasis and bone metabolism. It is now known that vitamin D has a large number of non-skeletal effects. [1] Based on observation of epidemiologic as well as prospective studies, vitamin D deficiency has been linked to increased risk of many chronic diseases such as autoimmune diseases, cardiovascular disease, malignancies, type II diabetes mellitus and infectious diseases. [2]

Vitamin D deficiency is accepted as a world-wide health problem [3] and widespread insufficiency or deficiency of vitamin D has been reported in countries of the Asia-Pacific including South-east Asia. [4]

There is currently no data available on vitamin D levels in Brunei Darussalam. The aim of the present study was to survey the level of vitamin D in a mixed population of subjects and assess the sources from

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which request for vitamin D level estimations were made.

MATERIALS AND METHODS

This retrospective study was conducted on subjects who had vitamin D testing from January 2012 to December 2012. Data on patient's age, gender, source of referral and vitamin D levels were obtained from the results maintained in the Clinical Chemistry Section of the Department of Laboratory Services. The study was approved by the Medical and Health Research and Ethics committee of the Ministry of Health.

Total serum vitamin D levels were measured by a chemiluminescence immunoassay method on a Siemens ADVIA Centaur analyser. The vitamin status was assessed according the following criteria: deficiency: <30 nmol/L, insufficiency: 30-50 nmol/L and adequate: >50 nmol/L.

The data was manually transcribed using a proforma and transferred to spreadsheet (Microsoft Excel 2010). Statistical analysis was done using SPSS version 10.0. Student *T* test was used to compare values between groups. A *p* value of <0.05 was considered statistically significant.

RESULTS

A total of 446 samples were tested. Complete data was available on 408 (Women 331, Men 77) subjects and has been included in the analysis.

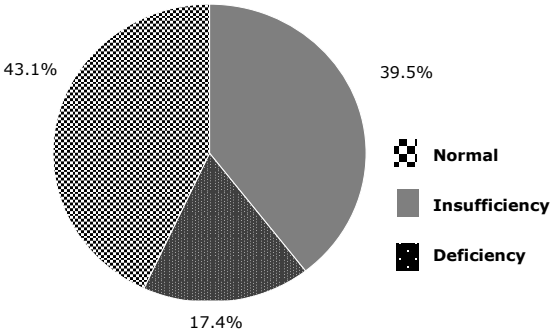

Fig. 1: Breakdown of patients and vitamin D levels.

Across the sample the mean ± SD of level of vitamin D was 50.4 ± 22.3 nmol/L. A total of 39.5% (n=161) had insufficiency, 17.4% (n=71) had deficiency and 43.1% (n=176) had normal vitamin D levels (Figure 1).

The vitamin D levels in men and women according to the cut-off values are presented in Table 1. Women had significantly lower level of vitamin D compared to men (47.9 ± 21.3 nmol/L vs 60.9 ± 23.7 nmol/L, $p<0.05$). Approximately, the numbers of women tested were four times more than men.

Subjects under 50 years of age had significantly lower level of vitamin D compared to those above 50 years (46.3 ± 20.1 vs 54.1 ± 23.6, $p<0.05$) (Table 2).

The most common source of request was the Internal Medicine Section (64.7%) followed by the Rheumatology (15.7%) and

Table 1: Vitamin D levels in men and women according to the cut-off values.

	Men			Women		
Vitamin D	**n**	**Mean ± SD**	**Total %**	**n**	**Mean ± SD**	**Total %**
<30 nmol/L	3	26.7 ± 0.6	3.9	68	25.1 ± 4.4	20.5
30-50 nmol/L	26	40.1 ± 6.3	33.8	135	39.6 ± 5.8	40.8
>50 nmol/L	48	74.3 ± 19.8	62.3	128	68.9 ± 18.5	38.7
Total	77	60.9 ± 23.7		331	47.9 ± 21.3	

Table 2: Vitamin D levels in men and women.

	n	Mean ± SD	*p*
Men			
‹ 50 years	38	55.5 ± 18.4	< 0.05
› 50 years	39	66.15 ± 27.1	
Women			
‹ 50 years	155	44.0 ± 19.9	< 0.05
› 50 years	176	51.4 ± 21.9	

Endocrinology clinic (5.1%). The remaining requests were from the Orthopaedic, Dermatology, Primary Health, Gynaecology-Obstetric, and Paediatric clinics.

DISCUSSIONS

In our study, more than 50% of subjects had either insufficiency or deficiency of vitamin D. It was found to be lower in women compared to men and those under 50 years of age. The Internal Medicine Unit was the most common source of referral for vitamin D estimation followed by the Rheumatology and endocrinology units.

The Asia-Pacific audit has shown that vitamin D insufficiency is common in the region. [4] The possible causes for this finding include urbanisation, low sun exposure, inadequate dietary intake of vitamin D, inadequate fortification with vitamin D, pigmentation of skin, environmental pollution and traditional dress code. [4]

In a review of 195 studies conducted across 44 countries, 37.3% of studies reported mean values of 25-Hydroxy vitamin D below 50 nmol/L. [5] In South-east Asia, the prevalence of vitamin D deficiency in community varies from 6-70% and the predictors for low vitamin D have been recognised as younger age, being female, urban residence and being less physically active, sun protection behavior and religious differences. [6]

Various studies from South-east Asia reporting on vitamin D levels is summarised in Table 3. Most of the studies in South-east Asia have been done in either pre- or post-menopausal women. [7, 8] A few studies have also included men. The studies have used different methods and units of assessment of vitamin D and the cut-off for defining insufficiency and deficiency is also varied. However most studies have used cutoff values same as that used in the present study. For the same reasons, it is also difficult to compare the results of the present study directly with those from the studies mentioned. However it is evident that a large number of subjects have vitamin D deficiency and insufficiency.

The latitude of Brunei Darussalam is $4^0$30′ North of the equator, similar to Thailand ($5^0$30′ North), Malaysia ($3^0$8′ North) and Singapore (1^0 North). The proximity of these places to the equator ensures sunlight all year round. However studies have confirmed lower vitamin D levels in subjects from these countries. [9-13, 15-20] The reasons put forward for this are industrialisation which reduces time spent by younger people outdoors, sun protective behaviour and skin pigmentation. [6, 12, 19] It is known that the production of vitamin D3 by the skin is also affected by the change in latitude, season of the year or time of the day. [24, 25]

Generally there is decline in vitamin D status with increasing age, possibly due to reduced sun exposure and decreased ability of skin to synthesise vitamin D. [26, 27] Studies comparing younger and older women have confirmed lower levels in younger women compared to older women. [14, 18, 19, 22] While Tan *et al*. found no correlation between vitamin D and age. [17] The reduced ability to synthesise vitamin D in elderly population may be compensated by more sun exposure and reduced sun protective behavior compared to younger subjects. In the present study patients under 50 years of age (both men and

Table 3: Summary of studies of vitamin D levels from South-east Asia.

Country	Authors	Sample	Cutoff	Prevalence
Indonesia	Sarmidi *et al.* [7]	N=42 (PMO); 51-77 years	Inadequacy: <50 nmol/L	61.9 %
Indonesia	Setiati *et al.* [8]	N=74 (elderly women); >60 years	Inadequacy: <50 nmol/L	35.1%
Malaysia	Rahman *et al.* [9]	Post menopausal women N=Malays 103; Chinese 173; 50-65 years	Insufficiency: 25-50 nmol/L	Malays: 71% ; Chinese: 11%
Malaysia	Green *et al.* [10]	N=504 (women); 18-40 years	Inadequacy: <50 nmol/L	Chinese: 38% ; Malays: 74%; Indians: 68%
Malaysia	Moy *et al.* [11]	N=380; 58% Female: 42% Male; 48.5 ± 5.2 years	Inadequacy: <50 nmol/L	Male: 41% ; Female: 87%
Malaysia	Nurbazlin *et al.* [12]	N=107 Urban; 293 Rural; women; >45 years	Deficiency: 30-50 nmol/L Insufficiency: <30 nmol/L	Urban Rural 37.4% 11.6% 43.9% 0.3%
Malaysia	Chin *et al.* [13]	N=383 (men); >20 years	Deficiency: <30 nmol/L Insufficiency: 30-50 nmol/L	0.5% 22.7%
Philippines	Raso *et al.* [14]	N=70 (Post Menopausal women); 70 ± 8 years	Inadequacy: 25-79 nmol/L	36%
Singapore	Robein *et al.* [15]	N=504; 56% Female : 44% Male ; 45-74 years	Inadequacy: <50 nmol/L	Male: 9% ; Female: 18%
Singapore	Hawkins [16]	N=240; Chinese : Malays : Indians 40 Female: 40 Male each 19-71 years	Inadequacy: <50 nmol/L	Chinese Malays Indians Male 30% 47% 75% Female 53% 77% 85%
Singapore	Tan *et al.* [17]	N=197 (women) ; 25-60 years	Inadequacy: <50 nmol/L	Chinese: 56% ; Malays: 86%; Indians: 82%
Thailand	Soontrapa *et al.* [18]	Women Urban 106 ; Rural 132 ; Post menopausal 98 Pre-Menopausal 357	Insufficiency: ≤35 ng/ml	Urban 65.4% ; Rural 15.4% Post menopausal 60.2% Pre Menopausal 77.8%
Thailand	Chailurkit *et al.* [19]	N=2,641; 50% Male and 50% Female; >40 years	Inadequacy: <50 nmol/L	Male: 1.9% ; Female: 9.3%
Thailand	Soontrapa *et al.* [20]	Urban Men	Insufficiency: ≤40 ng/ml	48%
Vietnam	Ho-Pham *et al.* [21]	N=637; 432 Female: 205 Male ; 18-87 years	Insufficiency: <30ng/ml	Male: 20% ; Female: 46%
Vietnam	Nguyen *et al.* [22]	N=691; 269 Female: 222 Male ; 13-83 years	Deficiency: <20ng/ml	Male: 16% ; Female: 30%
Vietnam	Laillou *et al.* [23]	N=595 (Pre-Menopausal women)	Deficiency: <30 nmol/L Insufficiency: 30-50 nmol/L	17% 40%

women) had lower levels of vitamin D compared to those above 50 years of age.

In agreement with the worldwide trend, the prevalence of vitamin D insufficiency is lower in men compared to women. [11, 15, 16, 19, 22] In women the prevalence of vitamin D insufficiency has ranged from 0.3% in rural Malaysian women [12] to 87% in urban Malaysian women. [11] In men, prevalence of vitamin D insufficiency has been reported to be from 1.9% in Thai men [19] to 41% in Malaysian men. [11] Nimitphong and Holick have proposed that the gender differences occur mainly due to clothing and sun protection measures taken by women. [6]

The level of vitamin D has been found to be lower in urban compared to the rural population. [12, 18, 19, 22] Nurbazlin *et al.* assessed the effect of sun exposure and found that urban women had significantly lower exposure. [12] The percentage of urban women using sunscreen when exposed to sun was also high compared to rural women. It is known that use of sunscreen significantly reduces vitamin D production. [28] Moy has also shown a positive correlation of sun exposure score and negative correlation of sun protection score with vitamin D levels. [11] The other factors which could contribute to the difference are air pollution, obstruction of sunshine by tall buildings [29] and the texture and colour of clothing. [30]

Lower level of vitamin D in veiled women has been reported in of number of studies, particularly from the Middle-East and South-East Asia. [8, 12] Islam *et al.* did not find any significant difference in the prevalence of vitamin D insufficiency in veiled and unveiled Bangladeshi women. [29] Bruneian women do not use the traditional veil but except their face, rest of the body is covered by their clothing.

Another variable explored has been the ethnicity of the subjects. Few studies have shown that vitamin D levels are highest in Chinese followed by Malay and Indian population. This has been found in both men and women and has been explained on the basis of skin pigmentation, difference in outdoor activities, clothing habits and attitude towards sunlight exposure. [9, 10, 16, 17]

It is clear that between 50-90% of vitamin D in the body is produced by the skin. This in turn depends on a number of factors including latitude, exposure to sunshine, clothing habits, use of sun protection and pigmentation of the skin. [6] There is reduction in capacity of skin to synthesize vitamin D with increased skin pigmentation. [28] Many Asian women take measures to avoid sunlight exposure and tend to have a negative attitude towards sunlight. [9, 10, 16, 17, 21]

About 35-40 hip fractures are reported every year in Brunei Darussalam. There is no data on the more common distal radius and vertebral osteoporotic fractures. If the number of subjects with diseases affecting vitamin D metabolism like endocrine, rheumatological gastrointestinal and renal diseases are considered, the potential number of subjects with vitamin D insufficiency and those who would benefit from estimation of vitamin D would be very high.

It is likely that all the variables discussed earlier and studied in subjects from South-East Asia have a role to play in the high prevalence of vitamin D insufficiency and deficiency in Brunei Darussalam. However it was not possible to study the impact of these variables in the present study.

The study has several limitations. Due to the retrospective design of the study, certain data were not available such as ethnic origin, patients' co-morbidities and their severity. It is likely that some patients had disease condition affecting vitamin D which some would have received vitamin D supplements. It was not possible to assess the role of clothing and sun protection behaviour as well. The request form did not indicate the sub-division of internal medicine from where the samples were sent, thus additional details were not available.

In conclusion, out study showed that vitamin D insufficiency and deficiency is common in Brunei Darussalam. Generally vitamin D testing is underutilised. There is a need for further studies to determine the prevalence and risk factor for vitamin D deficiency in general population and in specific disease states in Brunei Darussalam.

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