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SHORT COMMUNICATION

Illuminating the Dark Side - Vitamin D Status in Different Localities of Karachi

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ABSTRACT

This study was conducted to determine the association between place of residence (grouped into neighbourhoods), and 25-hydroxy D (25[OH]D) levels of individuals of Karachi. Addresses of 4788 individuals tested for 25[OH]D at the clinical laboratory of the Aga Khan University (AKU), Karachi, from January 2007 to June 2008 were reviewed. The neighbourhoods were categorized into ten, based on locality attributes. A high overall prevalence (74%) of vitamin D deficiency (VDD) was observed. There was a significant difference (p-value < 0.01) between mean log 25[OH]D levels amongst neighbourhoods grouped according to distinct housing structure attributes and localities. A high frequency of VDD in all the studied localities of an urban city warrant dietary vitamin D supplementation and food fortification.

Key Words: *Vitamin D. Deficiency. Urban. Localities. Housing.*

Vitamin D deficiency (VDD) is a global public health issue and is on the rise in Pakistani population. In a study, Pakistani immigrants in Norway had alarmingly low levels of 25-hydroxy D (25[OH]D) (< 24.9 nmol/L).[1] Seventy eight per cent of the hospital staff in Lucknow India were found vitamin D deficient.[2] Similarly, in a study conducted in Lahore, Pakistan VDD was observed in 81% of the pre-menopausal women.[3] A recent report from an adult ambulatory care setting in Karachi revealed 62% severe VDD.[4] In one of our studies on healthy volunteers, low serum 25[OH]D was found in 94.3% of the females and 88.6% of the males.[5]

Sunlight exposure is an important determinant of serum 25[OH]D levels. At an individual level, factors associated with low sunlight exposure include conservative clothing practices, use of sunscreens, darker skin tone, physical barriers such as glass windows of cars and offices, and house bound individuals who may have little exposure to sunlight. In addition to the individual level factors, household level factors may also influence sunlight exposure. A study on Saudi Arabian women showed severe VDD in apartment dwellers as compared to those women living in villas with more exposure to sunlight.[6] The aim of the present study was to study the association between place of residence and 25[OH]D levels of individuals.

Data of those who had 25[OH]D levels assessed (n = 19073) at the Aga Khan University (AKU), Clinical Laboratory, Karachi, from January 2007 to June 2008 were reviewed. Those samples from areas outside Karachi were excluded. Samples received from November to February were included in the winter season and summer months were from March to June. The residential addresses were categorized into ten neighbourhoods with distinct housing structure and locality attributes, for example residential areas with more apartments vs. residential areas with less apartments. Some of the neighbouring localities were merged together to get the ten neighbourhoods as follows: Group I: 'Clifton', Group II: 'Defence', Group III: 'Federal B Area', Group IV: 'Garden and Saddar', Group V: 'Gulshan and Gulistan-e Jauhar', Group VI: 'Landhi, Malir and Korangi', Group VII: 'North Nazimabad and North Karachi', Group VIII: 'PECHS and Bahadurabad', Group IX: 'Site, Orangi and Nazimabad' and Group X: 'PIB Colony'. The 25[OH]D tests were performed by electrochemiluminescence assay on Roche Modular E-170, U.S. The cut offs for 25[OH]D levels were taken as; > 75 nmol/L to be sufficient; 50 – 75 nmol/L to be insufficient; < 50 nmol/L as deficient.

Statistical Package of Social Sciences (SPSS) version 19 was used for data analysis. Mean ± SD for quantitative variables was computed. Serum 25[OH]D value was log transformed to obtain a normal distribution. Mean values comparison was done with paired t-test and ANOVA. Post-Hoc comparisons of log 25[OH]D were carried out using Bonferroni method. Two-tailed p-values < 0.05 were considered significant and < 0.01 as highly significant.

A total of 19,073 blood samples were analyzed for 25[OH]D from January 2007 – June 2008 at AKU Clinical Laboratory at Karachi, Pakistan. After excluding those without available information of residential address, a total of 4788 subjects were included (i.e., ~25%) in the study. Mean age of the participants was

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Table I: Vitamin D status in individuals residing in Karachi, Pakistan (n = 4788).

	Gender		Age groups (years)				Groups neighbourhoods									
	Male	Female	< 18	19 – 50	> 51		I	II	III	IV	V	VI	VII	VIII	IX	X
n	1393	3395	318	2128	2342	n	407	785	272	484	1013	346	529	521	100	331
Mean 25[OH]D	44.4	45.9	50.4	39.1	49.4	Mean log	1.15[a]	1.14[a]	1.08[b]	1.1[ab]	1.08[b]	1.06[b]	1.07[b]	1.11[ab]	1.07[b]	1.16[a]
(±SD) nmol/L	(±38.7)	(±35.1)	(±42.9)	(±34.1)	(±39.2)	25[OH]D	(±0.39)	(±0.37)	(±0.40)	(±0.38)	(±0.39)	(±0.40)	(±0.40)	(±0.38)	(±0.40)	(±0.36)
Deficiency	69.7	70.7	67	77.3	64.6	Deficiency	63.4	67.3	72.4	71.7	72.6	74.6	71.1	70.2	64	73.4
(%) (n)	(971)	(2400)	(213)	(1646)	(1513)	(%) (n)	(258)	(528)	(197)	(347)	(735)	(258)	(376)	(366)	(64)	(243)
Insufficiency	15.15	13.6	12.6	11.3	16.7	Insufficiency	18.4	14.9	12.9	14.3	13	9.5	14	15.2	19	12.1
(%)	(211)	(462)	(40)	(240)	(392)	(%)	(75)	(117)	(35)	(69)	(132)	(33)	(74)	(79)	(19)	(40)
Sufficiency	15.15	15.7	20.4	11.4	18.7	Sufficiency	18.2	17.8	14.7	14	14.4	15.9	14.9	14.6	17	14.5
(%)	(211)	(533)	(65)	(242)	(437)	(%)	(74)	(140)	(40)	(68)	(146)	(55)	(79)	(76)	(17)	(48)
p-value	< 0.01		< 0.01				< 0.01									

Vitamin D deficiency is defined as < 50 nmol/L, insufficiency as 50 – 75 nmol/L and sufficiency as > 75 nmol/L. Neighbourhood grouping was done as follows: Group I: 'Clifton', Group II: 'Defence', Group III: 'Federal B Area', Group IV: 'Garden and Saddar', Group V: 'Gulshan and Gulistan-e jauhar', Group VI: 'Landhi, Malir and Korangi', Group VII: 'North Nazimabad and North Karachi', Group VIII: 'PECHS and Bahadurabad', Group IX: 'Site, Orangi and Nazimabad' and Group X: 'PIB Colony'. Comparison between gender and age gropus was done using independent t test. comparison between neghborhoods was done using ANOVA and post hoc analysis. Mean with similar alphabets are statistically non-significant.(p-value < 0.05).

48.5 ± 18.6 years. The majority (70.9%) were females. Overall median estimate of 25[OH]D was 33.94 (IQR 3.99 – 196.6) nmol/L. Though all age groups were affected, however, more severe 25[OH]D was seen in 19 – 50 years age group ($p < 0.01$). Mean 25[OH]D levels were significantly different between males and females ($p < 0.01$). Similarly, mean log 25[OH]D levels were higher in summers (1.14 ± 0.37 nmol/L) as compared to winters (1.05 ± 0.41 nmol/L; $p < 0.01$).

Vitamin D deficiency was observed in 73.7% subjects, insufficiency in 13.8% and 12.5% were identified to have sufficient levels. Statistically significant difference between mean log 25[OH]D of participants residing in different neighbourhoods of Karachi was observed ($p < 0.01$). Post Hoc test results reflected that lowest 25[OH]D levels were observed in residents of Landhi, Malir and Korangi (Table I).

Average sunshine in Karachi is 304 hours/month during summer and 280 hours/month during winter. It is unclear why the prevalence of VDD was so high in all the ten localities despite stark differences in sunlight exposure related to the housing style of these neighbourhoods. Mean log serum 25[OH]D levels were highest in Clifton, Defence and PIB. Postpartition PIB colony was developed as the first planned residential colony for the immigrants built in a manner to provide basic living amenities with proper ventilation and sunlight. PIB Colony is a middle class neighbourhood and mostly has 150-square-yard houses having paved backyards. Whereas, Clifton has been a posh residential place since long. While, Defence Housing Authority is a relatively newer neighbourhood with all the modern amenities and the residents mostly belong to the upper echelon of the society.

Trends towards increased indoor living and the growing popularity of apartments in Karachi may be the cause of VDD through reduced exposure to sunlight. Other prevailing risk factors that may be attributed to the role of government are weak social and economic infrastructure in certain areas and insufficient intake of healthy food by a major portion of the population secondary to inflation. The dietary habits can also be blamed as food is often overcooked destroying most of the vitamins and micronutrients in it. Therefore, vitamin D intake through food was probably low.

Another hypothesis is that air pollution prevents adequate UV exposure to skin. The level of air pollution in Karachi is significantly higher than World Health Organization (WHO) standards.[7] A 2003 – 2004 air quality survey by Pakistan Space and Upper Atmosphere Research Commission showed bad air quality in Karachi. Mean (in 48 hours) cars, buses, trucks and rickshaws counted per day at monitoring sites were 6330, 6512, 1112 and 1161, respectively. All these could be contributing to defective UVB light penetration and hence VDD and this area needs to be thoroughly investigated.

Limitations of this report include the lack of information on housing structure. Quantitative measurement of time spent indoors / outdoors was missing, hence we could not use serum 25[OH]D as surrogate marker for sunlight exposure. Furthermore, one sample per individual is not sufficient to obtain a long-term 25[OH]D status.

The study indicates that both high and low-income localities of both urban and rural environments are at risk of developing VDD. A prospective study should be planned that includes the validation of dietary assessment tools for measuring the intake of vitamin D and calcium along with housing structures of each locality. The need to develop and validate sunlight exposure questionnaires to accurately capture vitamin D status also exists.

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