Calcium and vitamin D Nutrition and Bone Disease of the Elderly

[1]Sami Bahlas and [2]Maimoona Mushtaq Ahmed

[1]Consultant Rheumatologist / Associate Professor, King Abdulaziz University, Department of Medicine, Jeddah, Saudi Arabia
[2]Consultant Physician/ Associate Professor Internal Medicine, King Abdulaziz University, Department of Medicine , Jeddah, Saudi Arabia
drsamibahlas@gmail.com

Abstract: In this cross-sectional study, the prevalence of vitamin D deficiency [serum 25-hydroxyvitamin D (25 (OH) D) <50 nmol/L] was 87.8% among Saudi Arabian men. There was a linear inverse relationship between serum 25(OH) D and intact parathyroid hormone (PTH) levels, but without a threshold of 25(OH) D at which the intact PTH values become balanced. **Introduction:** Vitamin D insufficiency and/or deficiency have now reached epidemic proportions and have been linked to low bone mineral density (BMD) due to, certain lifestyle factors, and obesity in adults. This relationship is not well documented in Saudi Arabian men. This study examines the relationship between vitamin D status, intact parathyroid hormone (intact PTH), and lifestyle factors among Saudi Arabian men. **Methods:**This cross-sectional study has involved 1331 females (aged 6-98) and 169 males (aged 13-83) _ living in Saudi and Non-Saudi who were randomly selected and medically examined. **Results:**Deficiency (25(OH) D<50 nmol/L) and insufficiency (≥50–75 nmol/L) were presented. Deficiency (<50 nmol/L) were 91.4% in Non-Saudi, 91.2% in Saudi, and Insufficiency (>=50-<=75 nmol/L) were 8.6% in Saudi and 8.4% in Non-Saudi respectively. The Odds ratio for age group- 0.582 (LL (0.420) – UL (0.807)) and sex for clinical parameters. There is a significant negative correlation between Calcium and Alkaline Phosphate with (r= -0.065) and (p = 0.03). **Conclusions:**Vitamin D deficiency is wide spread in in Saudi and non-Saudi population, country where sunshine is abundant.it is important to pay attention to the high prevalence of vitamin D deficiency in the general adult population. It is necessary that the government implement a mandatory vitamin D supplementation program in primary health centers and raise awareness of the magnitude of the problem in vulnerable groups through social media, and educate the people of the importance of exposing themselves to direct sunlight for at least 30 minutes a day.

[Sami Bahlas and Maimoona Mushtaq Ahmed. **Calcium and vitamin D Nutrition and Bone Disease of the Elderly.** *Life Sci. J* 2014; 11(10):362-369] (ISSN: 1097-8135). http://www.lifesciencesite.com. 50

Keywords: Calcium intake, 25-Hydroxyvitamin D, Lifestyle factors, Elderly population, PTH. Saudi Arabia

1. Introduction

Osteoporosis is a serious global health problem and the prevalence increases as people live longer and the population continues to increase in number [1]. The true incidence of osteoporosis in the Saudi Arabian population ranged from 35-48% [2], specifically femoral fractures was 2.71/1,000 [3], which varies across the regions (1.29 and 2.8/1000) [4]. Fracture risk increases exponentially with age and with the decrease in bone mineral density (BMD), often associated with an increased rate of bone remodelling, resulting in net bone resorption and a consequent reduction in bone strength [5]. Another cause is the increase in fall incidence with ageing [6]. The main determinants of the age-related increase in bone turnover are the declining estrogens levels, changes in calcium and vitamin D metabolism and decrease in physical activity [7]. Nutrition plays an important role in bone health and there is consistent evidence from epidemiological studies, clinical trials and studies from animal models that inadequate supply of calcium and vitamin D has negative effects on bone health and also predispose to various types of cancer, chronic infections, inflammatory and autoimmune diseases, metabolic disorders, hypertension and several cardiovascular diseases [8-13].

In particular, reduced supply of calcium are associated with a reduced bone mass and osteoporosis, whereas a chronic and severe vitamin D deficiency leads to osteomalacia, a metabolic bone disease characterized by a decreased mineralization of bone and especially the elderly are at high risks in subject to this deficiency. The major causes are due to decreased renal hydroxylation of vitamin D, poor nutrition, and increased body fat, which results in reduced bioavailability of vitamin D, scarce exposition to sunlight due to immobility, lack of transportation, social isolation and a decline in the synthesis of vitamin D in the skin [14]. In the presence of inadequate vitamin D status, calcium absorption is lower than optimal and there is a compensatory increase in parathyroid hormone (PTH) levels, with a consequent stimulation of bone

resorption and accelerated bone loss [12]. Previous epidemiological studies have shown that elderly population are more prone to muscular weakness due to the declining vitamin D levels [15], further when serum 25(OH)D is lower than 50nmI/I, there is decreased physical performance [16] while lower than 25-30nmolI/I, there is an increased propensity to fall and fractures [17], including those of the wrist, humerus and hip [6,18].

Several studies consistently showed that Saudi population exhibit generally low serum 25(OH) D levels due to low vitamin D supplementations or limited exposure to sunlight due to lifestyle or clothing habits [19]. However, although lifestyle may be common to male and females, clothing factor perhaps not be applicable to male. Despite, these estimates, in the past decade bone diseases have been looked at more as a curiosity than a problem, although many studies had reported a high prevalence of osteoporosis [2, 20, 21]. Previous studies looked at Vitamin D status in relation to obesity, bone mineral density among Saudi Pre-post menopausal women [22] or general prevalence of fracture [23]. Given, these facts to our knowledge there is a paucity of data on the prevalence of vitamin D deficiency or insufficiency and its relationship with other markets such as calcium and vitamin D with bone health especially among elderly population. In fact, this study looked at whether these associations vary across nationality.

2. Methods

Age and gender matched patients were divided into two groups on the basis of BMI. Non-probability sampling method was employed to select both groups based on the attendance of the Medical Health center at King Faisal University by means of personal approach. The procedural method was confirmed only after getting approval from authorities of King Faisal University. Written consent was obtained from eligible candidates regarding the objectives, procedures implied and possible outcome of study. As per Helsinki Declaration of Medical Bioethics, data confidentiality has been maintained. Those with irregular outcomes were educated and eluded to KFUS' health office for management.

2.1. Exclusion and Inclusion Criteria

Cases and controls were screened for the likelihood of diabetes through the estimation of fasting blood glucose level; those with unusual results were rejected at the beginning. Non smokers were incorporated to overcome conceivable jumbling impact of smoking. Blood inspecting were withdrawn throughout spring season to overcome conceivable occasional variety of vitamin D levels (March twentieth to May 3rd 2009). Information was acquired through the review of individual health records. Members were barred assuming that they had negative history of any constant disease (particularly liver and renal sicknesses). No past utilization of prescriptions known to influence calcium metabolism "e.g., antiepileptic". • No known metabolic bone infections and malabsorption syndrome. • History of idleness for more than one month and vitamin D supplement. The reference runs utilized as a part of our lab for 25 (OH) vitamin D were as accompanies: 0–5 ng/ml (inadequacy), 5–39 ng/ml (shortage) and 40–100 ng/ml (adequacy).

2.2. Biochemical parameters

Blood specimens were gathered between 08:00 and 10:00 after an overnight quick at 0 and after 2, 5, 7, 10, 13, and 15 months (2 to 15). Calcium substance was broken down in EDTA plasma by nuclear assimilation spectroscopy (Perkin Elmer 1100) with air/acetylene at 2300°c. 12 hours later of fasting, blood specimens were gathered under institutionalized conditions for the accompanying biochemical tests: Serum calcium, 25 (OH) vitamin D, creatinine, and soluble phosphate.

Renal function tests: Concentrations of blood urea (BUN) and serum creatinine were dictated by dynamic UV test and creatinine Jaffe' packs individually.

Serum calcium:

Evaluated in serum utilizing colorimetric test unit.

25 (OH) vitamin D: Dictated by utilizing HPLC (Waters 2695 Alliance HPLC System with 996 photodiode Array Detector and Column Heater, American Laboratory Trading LLC, Groton, Ct, U.S.A), utilizing the accessible unit supplied by Chromsystems Diagnostic by HPLC (Instruments and Chemicals GMBH, Muenchen, Germany). Outcomes were communicated as µg/l.

2.3. Statistical Analysis

Outcomes are introduced as mean (±SD), and clear cut variables are communicated as frequencies. Information was broken down utilizing SPSS Statistical Package (form 15.0 for Windows Brilliant Viewer) supplied by SPSS Inc. 2000, Mapinfo Corp. Tokyo, NY, USA. Comes about that were not typically conveyed were log changed before examination. Companionships between constant variables were inspected by Pearson's connection coefficient. Men were separated into two major age bunches (i.e., ≤50 years versus ≥50 years, speaking to youthful versus old men). Additionally, men were stratified into distinctive age bunches: 20–29, 30–39, 40–49, 50–59, and ≥60 years to inspect the impact of

age on vitamin D status and different variables. Information dissection and preparing was completed utilizing SPSS rendition 16.0 (SPSS Inc, Chicago, Il, USA).Out of 95 obese subjects approached; 19 were excluded from the final data analysis (14 refused blood sampling, 5 with insufficient samples), in the lean group out of the 112 volunteered, 28 were excluded (20 refused blood sampling and 8 subjects with insufficient samples) Information showed non typicality utilizing Shapiro-Wilk test, were log converted with the end goal of dissection. Straight out information were communicated utilizing recurrence and rate. Chi-square test, Odd's proportion with 95% certainty interims was utilized as suitable. P<0.05 was acknowledged critical. Restricted Anova was utilized to inspect contrasts around the gatherings for distinctive variables, and the Bonferroni post hoc test was utilized when criticalness tests were made around the assemblies, and $\chi 2$ tests were utilized to think about frequencies. Free relationships between vitamin D status and different variables were assessed by multiple regression and partial connection breakdown.

3. Results

The clinical and biochemical data of the participants are shown in Table 1. There was a significant ($p < 0.001$) age difference between males and females: mean age 53 (SD 18) years versus 49 (SD 14) years respectively. Further, there was a no significant difference between males and females regarding the levels of calcium and Vitamin D (IU) levels. However, the serum creatinine levels and alkaline phosphate was significant difference between males and females. The levels of serum creatinine was still lower than the normal reference value for females in this age group (71-115 µmol/L), while serum calcium was higher in females but this was borderline in males.

Table 1: Clinical and biochemical parameters of participants

Variables	***Males (n=169)***	***Females (n=1331)***	***ANOVA (P value)***
Age (years)	53 ± 18 (83-13)	49 ± 14 (98-6)	**0.000****
Serum Calcium (mmol/L)	2.20±0.16 (2.6-1.0)	2.61 ± 8.67 (202.0-1.1)	0.593
Serum 25 (OH) Vitamin D (IU)	28.9 ± 13.5	29.5±14.5	0.731
Serum Alkaline Phosphate (U/L)	85.3 ± 45.9	78.8 ± 26.5	**0.007****
Serum Creatinine (mmol/L)	85.0 ± 18.1	65.1 ± 15.7	**0.000****

Values are Mean ± SD; *(Max-Min); NS- Not significant, ** - Significant.*

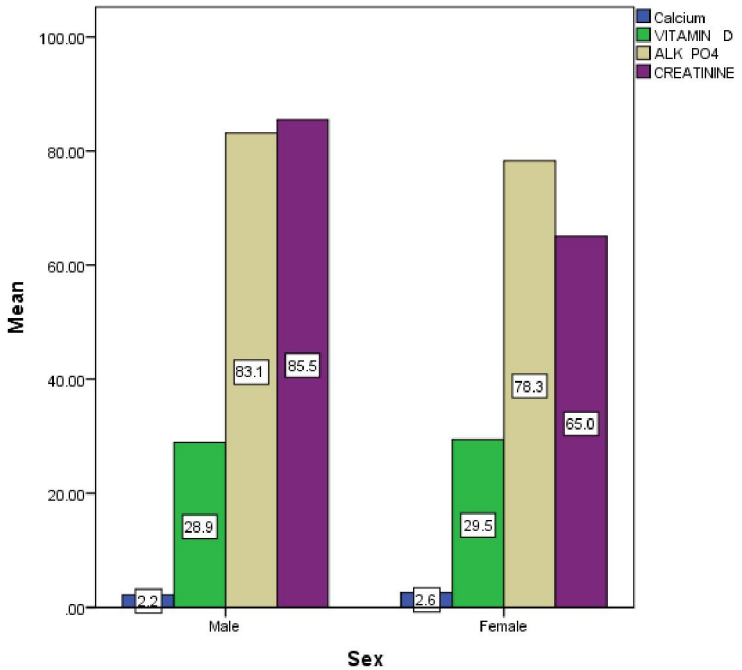

Figure 1: Bar chart for mean of calcium, Vitamin D, ALK PO4 and Creatnine by sex

Serum 25(OH) D levels were low; mean levels in males and females were 28.9 (SD 13.5) ng/mL and 29.5 (SD 14.5) ng/mL respectively (Figure 1). These 25(OH)D levels did not differ significantly between males and females. Of total 1499 respondents, 811 of them are from Saudi and 688 are Non-Saudis. The relationship between Vitamin D deficiency and type of country was analyzed with the help of Chi-square test. From Table 2, there was an insignificant difference in the prevalence of vitamin D deficiency among Saudi and Non-Saudi (p=0.984 >0.05), the prevalence of deficiency was found to be highest in both Saudi (91.2%) and Non-Saudi (91.4%), respectively. The prevalence of vitamin D deficiency (Insufficient) was higher in Saudi (8.6%) compared to Non-Saudi (8.4%) respectively (Figure 2).

Table 2: Prevalence of vitamin D deficiency in Saudi and Non-Saudi

Vitamin D Deficiency	***Country***		***P-value***
	Saudi	***Non-Saudi***	
< 50 nmol/L	740 (91.2)	629 (91.4%)	
< 12.5 nmol/L	0 (0.0%)	0 (0.0%)	
>= 12.5-<25 nmol/L	0 (0.0%)	0 (0.0%)	
>= 25-<50 nmol/L	0 (0.0%)	0 (0.0%)	0.984
>= 50-<= 75 nmol/L	70 (8.6%)	58 (8.4%)	
> 75 nmol/L	1 (0.1%)	1 (0.1%)	
> 100 nmol	0 (0.0%)	0 (0.0%)	
Total	**811 (100.0%)**	**688 (100.0%)**	

Values are presented as n (%); Phi-value- 0.005; NS- If P>0.05

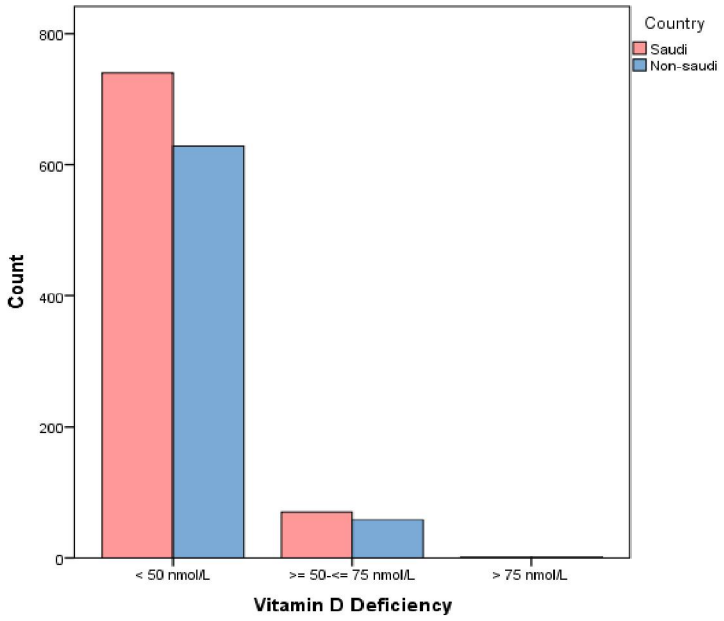

Figure 2: Bar chart for vitamin D deficiency for Saudi and Non-Saudi

Table 3 compares the clinical parameters and sex by age group. In age group <=50 years the Serum Creatinine significantly differs between male with mean (78.8) and female (61.2) (p < 0.001) and in age group >=51 both Vitamin D and Serum Creatinine was significantly different between male and female. Vitamin D with male has a mean (30.4) and female (31.1) while Serum Creatinine for male with mean (88.9) and female (69.2) (p < 0.001). The odds ratio for age group (0.582) with Lower limit (0.420) and Upper limit (0.807) respectively.

Table 3: Comparison of Calcium, Vitamin D, ALK PO4 and Creatinine between age groups

Age group	*Variables*	*Sex*		*P-value*
		Male	*Female*	
		Mean±SD (Max-Min)		
<= 50	Calcium	2.2±0.2 (2.4-1.0)	2.9±11.9 (202.0-1.9)	0.435
	VITAMIN D	28.3±14.8 (60.7-10.0)	27.4±14.2 (116.0-9.0)	0.320
	ALK PO4	81.7±29.1 (147.0-42.0)	78.1±27.2 (220.0-14.0)	0.412
	CREATININE	78.8±20.7 (108.0-27.0)	61.2±14.0 (119.0-6.0)	**0.001**
>= 51	Calcium	2.2±0.1 (2.6-1.9)	2.2±0.1 (2.9-1.1)	0.175
	VITAMIN D	30.4±12.6 (65.5-10.0)	31.1±14.7 (100.0-10.0)	**0.000**
	ALK PO4	87.7±54.3 (555.0-47.0)	79.5±25.8 (294.0-23.0)	0.344
	CREATININE	88.9±15.0 (128.0-44.0)	69.2±16.4 (113.0-0.0)	**0.000**

Bolded values represent significant; NS- If P>0.05;
Odds ratio for age group- 0.582 (LL (0.420) – UL (0.807))

There is a significant negative correlation between Calcium and Alkaline Phosphate with (r= -0.065) and (p = 0.03). However, Vitamin D and Serum Creatinine showed positive correlation (r = 0.099, p<0.001)

Table 4: Correlation between Calcium, Vitamin D and ALK PO4

Variables	*VITAMIN D*	*ALK PO4*	*CREATININE*
Calcium	-.019 (0.515)	**-.065*(0.025)**	-.025(0.397)
VITAMIN D	1	-.025(0.339)	**.099** (0.000)**
ALK PO4		1	.000(0.992)

*Figures in brackets represent the P-value; Bolded represents P<0. * represents P<0.05. ** represents P< 0.01.*

Table 5 compares the Vitamin D and Calcium, ALKPO4, Creatnine by sex . For male calcium has odds ratio (1.071) lower than female (2.571) . For male ALKPO4 has odds ratio (0.250) lower than female (0.970) and for creatnine female has higher odds ratio (2.259) than male (0.259).

Table 5: Comparison of Vitamin D with Calcium, ALK PO4 and Creatinine between sex

Sex	**Vitamin D Deficiency**	**Calcium**		**ALK PO4**		**Creatinine**	
		<=2.2	**>2.2**	**<=61**	**>61**	**<=56**	**>56**
Male	<50 nmol/L	72	42	27	126	8	134
		90.0%	89.4%	81.8%	94.7%	72.7%	91.2%
	>=50 nmol/L	8	5	6	7	3	13
		10.0%	10.6%	18.2%	5.3%	27.3%	8.8%
	Total	80	47	33	133	11	147
		100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Female	<50 nmol/L	651	328	307	886	337	811
		93.7%	85.2%	91.1%	91.3%	95.5%	90.3%
	>=50 nmol/L	44	57	30	84	16	87
		6.3%	14.8%	8.9%	8.7%	4.5%	9.7%
	Total	695	385	337	970	353	898
		100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Odds ratio: Calcium Male: 1.071, Female:2.571, ALKPO4 Male: 0.250, Female: 0.970, CREATNINE Male: 0.259, Female: 2.259

4.Discussion

Our study is the first in Saudi Arabia that address vitamin D status in elderly population. The prevalence of hypovitaminosis D was prevalent in 29.4% of the Saudiswhile 36.2 percent of non-Saudis suffered from vitamin D deficiency [24]. We reported low prevalence of vitamin D deficiency in general Saudi Arabian population (29.4%) while both Sedrani et al. [25] and Reiszadeh et al. [26] reported high (35%) in Saudi Arabia and Tehran respectively. However, in Scandinavian countries, the prevalence was as low as 4-9%. Nevertheless, all these reported among young healthy adult population.

We did find a significant but negative correlation between calcium and Alkaline Phosphate while positive between Vitamin D and Serum Creatinine. Past examination had elucidated the Saudi's adult intake of vitamin D is fifth of those similar to that of USA. However, there is no clear evident about the method used for determining such findings.

In ranges a long way from the equator the measure of UVB accessible from daylight throughout the winter months is lacking to permit cutaneous vitamin D union [27]. Notwithstanding, in Saudi Arabia there ought to be sufficient daylight to consider vitamin D blend [28]. Distinctive components can influence serum vitamin D level, incorporating skin pigmentation (blend diminishes in dull skin), ageing (vitamin D manufactured limit diminishes with ageing), the utilization of sun blocking executors, interminable renal, liver and gastrointestinal tract infections and the utilization of certain meds (e.g. anticonvulsants) [29, 30].

An alternate conceivable clarification of these low 25(OH)D levels in our associate of patients is that females in Saudi Arabia wear the universal Islamic shroud, which avoids the entrance of the UVB light required for the combination of vitamin D. Absolutely Hobbs et al. reported intense vitamin D insufficiency in Arab–American ladies who wear the cover [31]. Then again, this does not demonstrate why Saudi Arabian men had comparably low levels of vitamin D. Regardless of the possibility that we theorize that Saudi Arabians have a gently dull skin which could restrict the infiltration of UVB light, over 90% of members reported a sufficient admission of calcium and vitamin D rich nourishment items which might as well adjust for an absence of cutaneous combination of vitamin D. This prescribes that there are racial distinctions in the assimilation of calcium and vitamin D from the gut.

Our findings indicated that the commonness of 25 (OH) D lacks was high both in Saudi and non-Saudi elderly population. However, the percentage was higher in non-Saudi. The 25OHD synthesis declines with aging due to the thickness of skin which tapers down and the reduction in cutenous 7-dehydrocholesterol content and reduction mainly occurs in the dermis layer. Hence, the findings recommend the need to expand the fortress of nourishment items with vitamin D and screening for vitamin D insufficiency around the elderly as well as youthful Saudi adult people to anticipate future dismalness. The horribleness and mortality expands particularly around elderly with normal medicine expenses of SR48, 712 or US$12,990.00 for every patient [32] while administration expenses were US$1.14 billion. Saudis is between 30% and 42% and the rate of male osteoporosis is 20–30% [2,33] so on normal 31% of 1.46 million (453,000) men and ladies will oblige medication at a yearly cost of treating 1 patient of SR2, 000.00. Fracture medication will cause a crack diminishment of 42–80%, and generally change in the personal satisfaction, together with diminished horribleness and mortality. Between 1999 and 2004 there was an expansion in the Saudi populace matured 50 years and over from 878,884 to 1,461,401, and the assessed cost of administration of hip cracks climbed from SR1.77 billion (US$0.47 billion) to SR4.27 billion (Us$1.14 billion). Unless medicinal services suppliers and doctors try deliberations to diagnose osteoporosis early, treat it properly, and forestall cracks, the expense might further expand unchecked.

5. Conclusion and Recommendations

Based on obesity and BMI, the intake of vitamin D by Saudi's young adults is predicted. A negative relationship is identified between vitamin D and parathyroid hormone and insulin sensitivity among young adults. However, there is no statistically significant relationship identified after controlling the possible confounders. Hence, future studies should concentrate on the evaluation of bone mineral density with the reference ranges for adults in terms of age and sex. Another most important thing is to categorize the reference range in terms of season and ethnic background. Further studies are required to measure the level of skin pigmentation quantitatively and its association to vitamin D level and to screen biochemical parameters after vitamin D supplementation.These may help to establish if there are racial differences in vitamin D handling.

Corresponding author
Sami Bahlas
Consultant Rheumatologist / Associate Professor, King Abdulaziz University, Department of Medicine, Jeddah, Saudi Arabia
drsamibahlas@gmail.com

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