

**Prevalence of vitamin D deficiency among patients attending orthopedic clinic in Taif, Saudi Arabia:
A single center study**

Obadah Mohammed Hendi^{1*}, Abdulaziz Ahmed Abdulaziz¹, Abdulrahman Ahmad Alzahrani¹, Abdulrahman Abdulraof Mohammed², Abdulmajeed Mosfir Algethami³, Khalid Mohammed Alzahrani⁴

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Original Article

**Prevalence of vitamin D deficiency among patients attending orthopedic clinic in Taif, Saudi Arabia:
A single center study**

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ABSTRACT

Objective: The aim is to assess the prevalence of vitamin D deficiency among patients attending orthopedic clinics in King Abdul-Aziz specialist hospital in Taif city, Saudi Arabia.

Design: Retrospective study

Setting: King Abdul-Aziz specialist hospital, Taif city, Saudi Arabia

Subjects: 1475 patients involved from June 2016 to June 2017, during the period from 18 July to 12 September 2017, (Vitamin D level, calcium, phosphorus, parathyroid hormone, and alkaline phosphatase) were collected from the laboratory system, as well radiological findings from the radiology system. Socio-demographic data (age, gender, and nationality) were collected.

Intervention: Patients were classified according to Vitamin D level into deficient, insufficient, normal, and high.

Main Outcome measure: Vitamin D level and its correlation to different variables was measured using the statistical package for the social sciences program version 21.

Results: Among 1475 patients, 78% were females and 22% were males. Out of all patients, 53.1% had vitamin D deficiency, 27.8% had insufficiency, 15.4% had a normal level, and 3.7% had a high level. A higher prevalence of deficiency was found among males (60.3%) than female patients (51%, $p=0.009^*$). All age groups showed a high prevalence of deficiency, the highest was observed among ≤ 19 years age group (67.9%, $p=0.028^*$).

Conclusion: High prevalence of vitamin D deficiency is significant among all orthopedic patients. It is most common among male and adolescent patients.

KEY WORDS: osteoporosis, orthopedic outpatients, Saudi Arabia, vitamin D deficiency

INTRODUCTION

Vitamin D is one of the most important hormones in the regulation of bone metabolism and turnover. It also has an important relation to bone mineral density (BMD), as it is clearly affected by its deficiency, as well as its relation to bone fractures and osteoporosis^[1].

Vitamin D has an important role in the absorption and regulation of phosphorus, parathyroid hormone (PTH) and calcium, thus has a major role in bone mineralization and normal bone architecture. A deficiency of vitamin D is associated with osteoporosis and osteoporotic fractures as well as muscle weakness^[2]. A high prevalence of vitamin D deficiency is a worldwide health issue, especially among Middle Eastern countries, and it affects all age groups. The variety of gender, sunlight exposure, special habits, and cultural practices as clothing and dietary habits are all contributing factors to its deficiency^[3-7]. Studies in Saudi Arabia indicate that vitamin D deficiency is a major health problem with a high prevalence among Saudi population in all regions and among different age groups^[8-11]. The overall prevalence of deficiency was 60% and around 80% among female patients^[10,11]. Among orthopedic and trauma patients, many studies worldwide found a significant deficiency^[12-15]. An Indian single-center study found that around 91% of male and female patients had a deficiency^[12]. Another study carried out in Germany found that the mean of vitamin D level among 1119 orthopedic patients (males and females) was deficient^[13]. Maier *et al* found in another study, around 84% of orthopedic patients had insufficiency, out of them, 60% had a deficiency^[14]. In the United States, 71% and

62% of patients had insufficient or deficient vitamin D levels during winter and summer, respectively^[15]. In Saudi Arabia, a recent study carried out in Al-Qassim region among male patients attending rheumatology clinic found that 70% had vitamin D insufficiency^[16].

In Saudi Arabia, there is a shortage of studies assessing vitamin D deficiency among orthopedic patients. The aim of this study is to assess the prevalence of vitamin D deficiency among orthopedic patients attending orthopedic clinics in King Abdul-Aziz specialist hospital in Taif city, Saudi Arabia.

SUBJECTS AND METHODS

Study Design

A retrospective study to assess the prevalence of vitamin D deficiency among patients attending orthopedic clinics in King Abdul-Aziz specialist hospital -Taif city, from June 2016 to June 2017. Taif city is located in Makkah Province with an overall population of 987,914 (2010 census).

Data collection methods and procedure

Data were collected during the period from 18 July to 12 September 2017. We obtained the data by using patients' medical record numbers (MRN) and accessing laboratory system to collect vitamin D level, calcium, phosphorus, PTH, and alkaline phosphatase (ALP). Also, the radiological system was accessed to collect any associated radiological findings (osteoporosis, osteopenia, fractures, etc.) that were confirmed by computed tomography (CT), magnetic resonance imaging (MRI), or dual-energy x-ray absorptiometry (DEXA). In addition, socio-demographic data (age, gender, and nationality) were collected. We classified the patients according to vitamin D levels as normal, deficient, insufficient and high as per King Abdul-Aziz specialist hospital references lab ranges:

Normal: 25-Hydroxyvitamin D (25 OHD) 30-49.9 ng/ml

Vitamin D Insufficient: 25-Hydroxyvitamin D (25 OHD) 20–29 ng/ml

Vitamin D Deficient: 25-Hydroxyvitamin D (25 OHD) below 20 ng/ml

Vitamin D high: 25-Hydroxyvitamin D (25 OHD) 50 ng/ml or above

N.B. Vitamin D inadequacy (insufficiency + deficiency): 25-Hydroxyvitamin D (25 OHD) <30ng/ml

Vitamin D sufficiency (Normal +high): 25-Hydroxyvitamin D (25 OHD) >30ng/ml

Inclusion criteria

All patients attending orthopedic clinics at King Abdul-Aziz specialist hospital (males and females). The patients must have at least one laboratory result of vitamin D during the mentioned period to be included in our study.

Exclusion criteria

We excluded patients less than 10 years and older than 80 years, patients not attending orthopedic clinics, patients with no available vitamin D results on the system, and results before or after the mentioned period of study.

Ethical considerations

This study was approved by the Research Ethics Committee of Taif University and Institutional Review Board. The collected data were kept in confidentiality and patients MRN were replaced with ordinal numbers for further confidentiality.

Data analysis

Statistical analysis was carried out using the statistical package for the social sciences program (SPSS 21). Descriptive analysis was carried out to detect prevalence, mean, and quantitative variables. Chi-square and t-test were used to assess the correlation between vitamin D deficiency and other variables.

RESULTS

Our study included 1475 patients (78% females and 22% males), with a mean age of 47.7 ± 15.8 years. The maximum age was 80 years while the minimum age was 11 years. Most of the patients were Saudi (87.5%). The mean vitamin D level was 21.3 ng/ml and the lowest level was 1.7 ng/ml. Out of all participants, 53.1% had vitamin D deficiency, 27.8% had insufficiency, 15.4% had a normal level, and only 3.7% had a high level. Regarding other laboratory results, out of all participants, only 213 (14.4%) had available PTH results and 279 (18.8%) had available phosphorus results. Out of them, 64.3% and 88.5% had normal PTH and phosphorus levels respectively, while 84.5% and 75.7% of participants had available ALP and calcium results respectively. Out of them, 84.6% had normal ALP level and 85.9% had serum calcium within normal range as shown in Table 2.

Out of all participants, 62.2% had no radiologically confirmed diagnosis. Among diagnosed individuals the most frequent diagnosis was disc disease (disc prolapse and degenerative disc, 20.3%) followed by osteopenia (13.5%) and the least frequent was spondyloarthropathy (2.7%). Other diagnoses such as fracture, osteoarthritis, joint effusion, and joint replacement represented 47.9% as shown in Table 1. Out of all female patients, 51% had a deficiency, while among male patients, 60.3% had a deficiency. Only 16.8% of females and 10.5% of males had normal levels of vitamin D as shown in Table 3. The highest prevalence of deficiency was observed among patients with anterior cruciate ligament (ACL) injury (76.9%) followed by femur fracture (66.7%), and the lowest prevalence was observed among patients with spondyloarthropathy (26.7%) as shown in Table 4. Regarding ALP and calcium levels, 69.4% of patients with a high ALP level, and 58.9% with a low calcium level had a deficiency ($p=0.000^*$ and 0.009^*) respectively as shown in Table 5.

DISCUSSION

Vitamin D deficiency is a common health issue with a high prevalence worldwide and in Saudi Arabia as reported by many studies^[3,11]. However, no previous studies among orthopedic patients in Saudi Arabia been reported, while many studies worldwide indicate the significance and the high prevalence of deficiency. Our study found that out of 1475 patients, 80.9% had inadequacy out of them, 53.1% had a deficiency, while 19.1% had a sufficient level. These findings are consistent with many studies^[12,14,15,17-19]. A higher prevalence of deficiency was reported in India out of 1132 orthopedic patients, 91% had inadequacy among them, 61%

had deficiency and only 8.7% had a sufficient level of vitamin D^[12]. Another study showed even a higher prevalence among Indian patients who presented with orthopedic trauma; 95% had inadequate level, 82% of them had deficiency, while only 5% had a sufficient level, which exhibits the highest prevalence of deficiency^[17]. In another study among 889 orthopedic trauma patients, 77% had an inadequate level^[18]. Also, among 1119 German orthopedic patients, 84% had an insufficient level, and 60% had a deficient level^[14]. Among United States' orthopedic trauma patients, 71% had a deficiency during the winter and 62% during summer 62%^[15]. Also, among 723 patients scheduled for orthopedic surgery in New York, 43% had insufficiency, among them, 40% were vitamin D deficient^[19]. Even among rheumatology patients, 90% out of 60 Saudi male patients had vitamin D inadequacy, 70% had a deficiency, and only 10% had a sufficient level^[16]. This may imply a correlation between some diseases and vitamin D deficiency. However, a single study reported a low prevalence of deficiency among 488 healthy Saudi adults as only 29% had a deficiency and 22% had insufficiency^[9], which disagrees with all previously mentioned studies. However, this may be owing to the variation of prevalence between healthy individuals and orthopedic patients, which need further investigations and evaluation. Many risk factors are known to contribute to vitamin D deficiency, such as sunlight exposure, skin color, *etc* ^[2,3,20], but some factors are still controversial. Many studies stated that gender is not a significant risk factor for vitamin D deficiency among orthopedic patients^[12,14,17,18]. However, we found that deficiency was observed more among male patients, which was statistically significant ($p = 0.009$). These findings are consistent with other studies^[19], while others indicate that male gender is a probable risk for vitamin D deficiency^[21]. While regarding the age as a risk factor, our study found that vitamin D was deficient among all age groups which was statistically significant, with the highest prevalence among adolescent patients ($p = 0.028$), which is consistent with other studies^[12,19]. However, these findings conflict with other studies as it reported older age as a potential risk factor ($p \leq 0.10$),^[21] or it is not significant at all^[18]. Regarding lab results, our study found that p-value was significant for calcium and ALP levels, which is consistent with the normal physiology^[2].

Limitations

Although our study has achieved its aim, there were some limitations. The limitations of this study were that some required data as diagnosis and laboratory results were not available on the hospital system and considered as missing data. Also, some diagnoses were not radiologically confirmed (CT, MRI, or DEXA) or without report as osteoarthritis, joint effusion, strain, joint replacement, and fractures were collected under the category (others). Another limitation was that insufficient sample of patients with a specific diagnosis might affect the prevalence accuracy and the relation to vitamin D level.

CONCLUSION

There is a high prevalence of vitamin D deficiency among all orthopedic patients of all age groups with statistically significance values. With a higher prevalence among males and adolescent patients, which reflects that age and gender are risk factors that need further study and investigations, as well as treatment.

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Table 1: General characteristics

	Variable	Count	%
Nationality	Saudi	1290	87.5%
	Non-saudi	185	12.5%
Age	≤19	81	5.5%
	20-40	390	26.4%
	41-60	694	47.1%
	61-80	310	21.0%
Gender	Male	325	22.0%
	Female	1150	78.0%
Diagnosis	ACL injury	13	2.3%
	Disc disease	113	20.3%
	Femur fracture	18	3.2%
	Normal BMD	25	4.5%
	Osteopenia	75	13.5%
	Osteoporosis	31	5.6%
	Spondyloarthropathy	15	2.7%
	Others	267	47.9%

Table 2: Laboratory results

	Variable	Count	%
Vit D category	Deficiency	783	53.1%
	Insufficiency	410	27.8%
	Normal	227	15.4%
	High	55	3.7%
PTH	Low	2	0.9%
	Normal	137	64.3%
	High	74	34.7%
Phosphorus	Low	18	6.5%
	Normal	247	88.5%
	High	14	5.0%
ALP	Low	35	2.8%
	Normal	1055	84.6%
	High	157	12.6%
Calcium	Low	141	12.6%
	Normal	959	85.9%
	High	16	1.4%

Table 3: Relation of Vitamin D to general characteristics

Variable	Vit D category				Chi-square	p-value	
	Deficiency	Insufficiency	Normal	High			
	Count (Row N%)						
Nationality	Saudi	690 (53.5%)	352 (27.3%)	200 (15.5%)	48 (3.7%)	1.366	0.714
	Non-saudi	93 (50.3%)	58 (31.4%)	27 (14.6%)	7 (3.8%)		
Age	≤19	55 (67.9%)	19 (23.5%)	6 (7.4%)	1 (1.2%)	9.104	0.028*
	20-40	260 (66.7%)	94 (24.1%)	33 (8.5%)	3 (0.8%)	50.017	0.000*
	41-60	332 (47.8%)	205 (29.5%)	121 (17.4%)	36 (5.2%)	19.267	0.000*
	61-80	136 (43.9%)	92 (29.7%)	67 (21.6%)	15 (4.8%)	17.949	0.000*
Gender	Male	196 (60.3%)	85 (26.2%)	34 (10.5%)	10 (3.1%)	11.555	0.009*
	Female	587 (51.0%)	325 (28.3%)	193 (16.8%)	45 (3.9%)		

Table 4: Relation of Vitamin D to different diagnoses

Variable	Vit D category				Chi-square	p-value
	Deficiency	Insufficiency	Normal	High		
	Count (Row N %)					
ACL injury	10(76.9%)	3(23.1%)			24.562	0.137
Disc disease	60(53.1%)	32(28.3%)	18(15.9%)	3(2.7%)		
Femur fracture	12(66.7%)	5(27.8%)	1(5.6%)			
Normal BMD	13(52.0%)	6(24.0%)	5(20.0%)	1(4.0%)		
Osteopenia	34(45.3%)	17(22.7%)	16(21.3%)	8(10.7%)		
Osteoporosis	12(38.7%)	12(38.7%)	6(19.4%)	1(3.2%)		
Spondyloarthropathy	4(26.7%)	4(26.7%)	5(33.3%)	2(13.3%)		

Table 5: Relation of Vitamin D to laboratory results

Variable	Vit D category								Chi-square	p-value	
	Deficiency		Insufficiency		Normal		High				
Count (Row N %)											
PTH	Low					2 (100.0%)				8.750	0.188
	Normal	66	(48.2%)	34	(24.8%)	28	(20.4%)	9	(6.6%)		
	High	40	(54.1%)	17	(23.0%)	14	(18.9%)	3	(4.1%)		
phosphorus	Low	10	(55.6%)	5	(27.8%)	2	(11.1%)	1	(5.6%)	4.246	0.643
	Normal	137	(55.5%)	58	(23.5%)	41	(16.6%)	11	(4.5%)		
	High	11	(78.6%)	1	(7.1%)	1	(7.1%)	1	(7.1%)		
ALP	Low	16	(45.7%)	14	(40.0%)	5	(14.3%)			27.306	0.000*
	Normal	524	(49.7%)	304	(28.8%)	183	(17.3%)	44	(4.2%)		
	High	109	(69.4%)	34	(21.7%)	12	(7.6%)	2	(1.3%)		
Calcium	Low	83	(58.9%)	31	(22.0%)	26	(18.4%)	1	(0.7%)	17.155	0.009*
	Normal	498	(51.9%)	266	(27.7%)	151	(15.7%)	44	(4.6%)		
	High	5	(31.3%)	4	(25.0%)	7	(43.8%)				