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Serum Vitamin D Testing – A Necessity Or An Injudicious Expenditure?

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ABSTRACT

Objective: To evaluate the serum vitamin D levels and to determine the justification for vitamin D testing in patients.
Study Design: Cross-Sectional study.
Place and Duration of Study: Department of Chemical Pathology, Armed Forces Institute of Pathology Rawalpindi, Pakistan from Oct to Dec 2022.
Methodology: Patients of either gender coming for vitamin D level estimation were included. Vitamin D levels were analyzed on Immunoassay auto-analyzer. Data was analyzed using SPSS version 26.
Results: Out of 249 patients, 87(34.9%) were male while 162(65.1%) were female, with mean age 41.09±19.10 years and mean Vitamin D levels 73.08±45.86nmol/l. None of the patients (0%) had vitamin D deficiency, 174(69.9%) had vitamin D insufficiency, 72(28.9%) had vitamin D sufficiency, while 3(1.2%) had vitamin D excess. Major reasons for Vitamin D testing was bone pains, which were present in 72(28.9%) patients. A significant difference in vitamin D levels according to reason of testing (p<0.05) was observed. Total expense on vitamin D testing for 249 patients was PKR 722100/- (249x2900), as compared to cost of supplementation PKR 199200/- (249x800) in clinical suspected cases.
Conclusion: Majority of patients that tested for vitamin D were in lower risk group, and were not vitamin D deficient, with bone pains being the complaint due to which most patients were tested.

Keywords: Cost-Effectiveness, Vitamin D, Vitamin D Deficiency, Vitamin D Supplementation.

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INTRODUCTION

Vitamin D is essential for maintaining calcium and bone homeostasis.[1] The chronic deficit is linked to an increased incidence of hypertension, type 1 diabetes mellitus, multiple sclerosis, or cancer in addition to being linked to rickets, osteomalacia and osteoporosis.[2,3] Vitamin D3 is the most common type of vitamin D in humans, and endogenous production in the skin meets 80-90% of vitamin D requirements. The amount of vitamin D synthesized by the skin is determined by the length of time spent in the sun, the season of the year, and latitude.[4]

The predominant form of vitamin D in circulation is 25-hydroxyvitamin D, which can be used to screen for vitamin D deficiency in at-risk patients with chronic renal disease, liver failure, use of certain drugs, older adults, those with limited sun exposure, malabsorption disorders.[5]

The prevalence of severe vitamin D deficiency is 5.9% in the United States, 7.4% in Canada, and 13% in Europe. While in Asian countries like Pakistan, Afghanistan and India the prevalence of Vitamin D deficiency is found to be up to 20%.[6] In recent years, the number of vitamin D tests prescribed in general practice has increased significantly. Vitamin D is the fifth most frequently advised laboratory test in the United States costing over USD 350 million. Potentially inappropriate testing occurs when individuals are tested, who do not belong to specified high-risk groups. This over testing may lead to increased workload on health care delivery system and financial implications on individuals and society without any significant benefit to health.[7]

Keeping in view the current clinical practices and economic situation of the country, this study was conducted to evaluate the vitamin D status and to find out the major reasons for vitamin D testing in Pakistan.

METHODOLOGY

The Cross-Sectional study was conducted at Department of Chemical Pathology and Endocrinology, Armed Forces Institute of Pathology (AFIP) Rawalpindi, Pakistan, from October to December, 2022 after approval from the Institute Ethical Committee (Cons-CHP-1/READ-IRB/23/1803).

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Inclusion Criteria: Patients of either gender irrespective of age, who were advised vitamin D test and reported to AFIP, Rawalpindi for sample submission were included.

Exclusion Criteria: Hemolyzed, Icteric and Lipemic samples were excluded from the study.

Sample size was calculated by WHO sample size calculator taking 20% as prevalence of vitamin D deficiency in Pakistan[6]. Sampling was done using non-probability consecutive sampling technique. After obtaining Informed written consent, history was taken keeping in view all relevant indications for vitamin D testing. Blood samples were collected, and serum was separated. Analysis of 25-hydroxyvitamin D was carried out on automated Immunoassay analyzer. Controls were run on the analyzer and plotted on Levey-Jennings (LJ) chart before analysis and evaluated using Westgard rules. Based on vitamin D levels patients were divided into 04 groups; Deficient (<25 nmol/l), Insufficient (25-75 nmol/l), Vitamin D Sufficient (75-250 nmol/l) and Excess (>250 nmol/l).[8]

Analysis of data was done using Statistical Package for Social Sciences (SPSS) version 26. Mean±SD was used for quantitative variables whereas percentage and frequencies were used for qualitative variables. Chi-square test was used to compare frequencies of Vitamin D status in different groups. The *p* value ≤ 0.05 was considered as significant.

RESULTS

A total of 249 patients were included in the study out of which 87(34.9%) were male while 162(65.1%) were female. The mean age of patients was 41.09±19.10 years. Average serum Vitamin D levels in all patients were 73.08±45.86 nmol/l, whereas the average levels in males were 77.79±42.75 nmol/l while in females the average levels were 70.55±47.38 nmol/l. Out of all the patients, 72(28.9%) had vitamin D sufficiency (75-250 nmol/l), 174(69.9%) had vitamin D insufficiency (25-75 nmol/l), while only 3(1.2%) had vitamin D excess (>250 nmol/l) surprisingly there was not a single patient with vitamin D deficiency (<25 nmol/l). Patients were divided into different age groups. Amongst all age groups 195(78.4%) had ages between 19-60 years (Figure-1).

Only 60(24.1%) patients had disease history mentioned on their laboratory request form. While missing clinical details regarding the reason for vitamin D testing was taken from rest of the patients during submission of sample in the laboratory. The major reason for Vitamin D testing was found to be bone pains which were present in 72(28.9%) patients. There was significant difference in frequencies of Vitamin D status (Insufficiency, Sufficiency and Excess) as shown in Table.

Table: Status of Vitamin D With Different Reasons For Testing (n=249)

Reasons for Testing	Insufficiency	Sufficiency	Excess	Total	*p*-value
Bone Pain	42(58.3%)	27(37.5%)	3(4.2%)	72	<0.001
Generalized Weakness	39(86.7%)	6(13.3%)	0(0%)	45	
Bone deformity	21(87.5%)	3(12.5%)	0(0%)	24	
Pregnancy	24(100%)	0(0%)	0(0%)	24	
Renal disease	15(50%)	15(50%)	0(0%)	30	
Epilepsy	3(50%)	3(50%)	0(0%)	6	
Steroid Therapy	3(50%)	3(50%)	0(0%)	6	
Vit D supplementation	9(42.9%)	12(57.1%)	0(0%)	21	
Routine check-up	18(85.7%)	3(14.3%)	0(0%)	21	
Total	174(69.9%)	72(28.9%)	3(1.2%)	249	

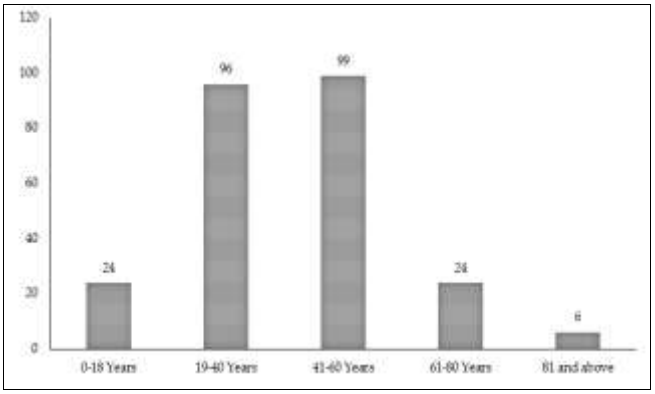

Figure: Frequency of Vitamin D testing Age GroupWise (n=249)

Amongst female patients, 123(75.9%) had insufficient, 36(22.2%) had sufficient and 3(1.9%) had excess vitamin D levels. While in male patients, 51(58.6%) had insufficient and 36(41.4%) had sufficient vitamin D levels.

The total cost for vitamin D testing for 249 patients was calculated to be PKR 7,22,100/-

(249x2900). The cost effect for supplementation would have been PKR 199,200/- (249x800) for four divided doses of vitamin D supplements. Vitamin D testing was only justified in 3(1.2%), patients who were in excess group for monitoring of vitamin D toxicity.

DISCUSSION

Vitamin D testing has increased significantly in the last 15 years, despite debate in vitamin D research and clinical standards. Low value care, which is characterized as clinical procedures that offer little to no benefit or could even be harmful, accounts for a sizable portion of wasteful health care spending. Non indicated testing has been demonstrated to account for a significant amount of this testing and is seen as a source of low-value health care.[9] The Choosing Wisely Campaign along with other societies such as US Preventive Services Task Force, US Endocrine Society and the National Academy of Medicine do not recommend population based screening or vitamin D testing in low risk population because of insufficient proof of both benefits and hazards and it should only be confined to patients with high risk of vitamin D deficiency.[10-12] It is estimated that more than one billion vitamin D tests are ordered annually around the world, 25% to 75% of these tests follow a pattern of non-indicated screening as opposed to testing of high-risk patients which supports the results from our study.[13] Overusing screening and diagnostic tests has been linked to an increased risk of patient harm in addition to cost burden.[14]

The findings of our study were that mean age of patients were 41.09±19.10 years and most of the patients who were advised vitamin D testing were female (65.1%). Majority of patients had insufficient vitamin D levels with mean value of 73.08±45.86 nmol/l. Contrary to indication for vitamin D testing in extremes of ages; we found that majority of patients who were advised vitamin D levels were in middle age group. The major reason for vitamin D testing was found to be bone pains (28.9%). In such patients the mean Vitamin D levels were 87.9±58.30nmol/l. It was followed by generalized weakness (18.1%) who had mean vitamin D levels of 62.4±30.5nmol/l. In a study conducted by Zuberi *et al*. (n=119) the mean age of patients who were tested was 44.3±18.32 years, and the ratio of females to males was 5:1. 62% of patients had vitamin D deficiency with levels < 20nmol/l and the most prevalent reason for requesting a vitamin D level was generalized myalgias and bone pains (51%).[15]

Similar results were found in other studies. Essig *et al*. (n=200,046) analyzed Swiss health insurance data (SWICA) for the incidence of vitamin D lab testing indicated the presence of potentially inappropriate testing alongside valid medical indications.[16] The elderly are at a significant risk for vitamin D deficiency, but they were tested less frequently than younger seniors. This finding is consistent with findings from other medical disciplines, indicating that advanced age may be associated with lower diagnostic testing rates. In another study conducted by Woodford *et al*.[17] (n=17,405) found that there was a drastic increase in the trend towards vitamin D testing in past decade. The percentage of females tested was 70.3% and nearly 40% of tests were conducted on patients between the ages of 30 and 60 years. It was found that only 22.4% of testing was found to be appropriate while 77.5% were inappropriate. Generalized tiredness (including fatigue, malaise, and exhaustion) accounted for 22.4% of all testing. Further studies have recommended that even if individual characteristics, including the 25(OH)D status, are unknown, a vitamin D supplementation dose of 800 to 1000 IU per day can ensure adequate vitamin D status regardless of the test result.[18] Apart from supplementation other measures include finding the correct balance between sun exposure and sun protection, as well as behavioral changes such as quitting smoking and increasing physical activity could also be considered. In our study the total cost for vitamin D testing of 249 patients was calculated to be PKR 722100/- (249 x 2900) while the cost of vitamin D supplementation which provides an alternative approach to combat deficiencies would have been around PKR 199200/- (249 x 800) for four divided doses of vitamin D. By comparing the cost of testing to the cost of supplementation it becomes evident that choosing the latter option presents a significant cost saving opportunity without compromising the health outcomes. We would recommend that to avoid unnecessary economic burden, the likelihood of very low vitamin D levels prior to testing must be contemplated. The test is appropriate if the risk of severe vitamin D deficiency is considerable, i.e., if patients belong to the pre-specified risk groups. In patients with low risk of vitamin D deficiency, testing can be avoided and such patients can be managed on supplementation. Adhering to these recommendations would reduce the possibility of unwarranted testing and we can efficiently utilize the healthcare budget of a developing country like Pakistan.

CONCLUSION

Majority of patients that tested for vitamin D were in lower risk group. Majority of those being tested complained of bone pains. Preventive measures and supplements may be convenient and cost effective.

Conflict of Interest: None.

Authors Contribution

Following authors have made substantial contributions to the manuscript as under:

AIP & MQAK: Data acquisition, data analysis, drafting the manuscript, critical review, approval of the final version to be published.

MY & ZHH: Study design, data interpretation, drafting the manuscript, critical review, approval of the final version to be published.

MA & MUM: Conception, data acquisition, drafting the manuscript, approval of the final version to be published.

Authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

REFERENCES

1. 1.Giustina A, Adler RA, Binkley N, Bollerslev J, Bouillon R, Dawson-Hughes B, et al. Consensus statement from 2nd International Conference on controversies in vitamin D. Rev Endocr Metab Disord 2020; 21(1): 89–116. http://doi.org/10.1007/s11154-019-09532-w
2. 2.Bouillon R, Marcocci C, Carmeliet G, Bikle D, White JH, Dawson-Hughes B, et al. Skeletal and extraskeletal actions of vitamin D: Current evidence and outstanding questions. Endocr Rev 2019; 40(4): 1109–1151. http://doi.org/10.1210/er.2018-00126
3. Janoušek J, Pilařová V, Macáková K, Nomura A, Veiga-Matos J, Silva DD, et al. Vitamin D: sources, physiological role, biokinetics, deficiency, therapeutic use, toxicity, and overview of analytical methods for detection of vitamin D and its metabolites. Crit Rev Clin Lab Sci 2022; 59(8): 517–554. http://doi.org/10.1080/10408363.2022.2070595
4. Borel P, Caillaud D, Cano NJ. Vitamin D bioavailability: state of the art. Crit Rev Food Sci Nutr 2015; 55(9): 1193–1205. http://doi.org/10.1080/10408398.2012.688897
5. Essig S, Merlo C, Reich O, Trottmann M. Potentially inappropriate testing for vitamin D deficiency: a cross-sectional study in Switzerland. BMC Health Serv Res 2020; 20: 1-8. https://doi.org/10.1186/s12913-020-05956-2
6. Amrein K, Scherkl M, Hoffmann M, Neuwersch-Sommeregger S, Köstenberger M, Tmava Berisha A, et al. Vitamin D deficiency 2.0: an update on the current status worldwide. Eur J Clin Nutr 2020; 74(11): 1498–1513. http://doi.org/10.1038/s41430-020-0558-y
7. Hofstede H, van der Burg HAM, Mulder BC, Bohnen AM, Bindels PJE, de Wit NJ, et al. Reducing unnecessary vitamin testing in general practice: barriers and facilitators according to general practitioners and patients. BMJ Open 2019; 9(10): e029760. http://doi.org/10.1136/bmjopen-2019-029760
8. Vitamin D. South Tees Hospitals. NHS Foundation Trust;2021. [Internet]. Available at: https://www.southtees.nhs.uk/services/pathology/tests/vitamin-d/ (Accessed on December 8, 2022)
9. Rockwell MS, Wu Y, Salamoun M, Hulver MW, Epling JW. Patterns of clinical care subsequent to nonindicated vitamin D testing in primary care. J Am Board Fam Med 2020; 33(4): 569–579. http://dx.doi.org/10.3122/jabfm.2020.04.200007
10. Rockwell MS, Wu Y, Salamoun M, Hulver MW, Epling JW. Patterns of clinical care subsequent to nonindicated vitamin D testing in primary care. J Am Board Fam Med 2020; 33(4): 569-579. https://doi.org/10.3122/jabfm.2020.04.200007
11. LeFevre ML. Screening for vitamin D deficiency in adults: U.S. Preventive Services Task Force recommendation statement. Ann Intern Med 2015; 162(2): 133–140. https://doi.org/10.7326/M14-2450
12. Holick MF, Binkley NC, Bischoff-Ferrari HA. Evaluation, treatment, and prevention of vitamin D deficiency: an Endocrine Society Clinical practice guideline. J Clin Endocrinol Metab 2011; 96: 1911–1930. https://doi.org/10.1210/jc.2011-0385
13. Excellus: low value vitamin D testing in upstate NY. [Internet]. Available at: https://www.bcbs.com/news/press-releases/most-people-dont-need-vitamin-dtesting. (Accessed on December 8, 2022)
14. Rozario NL, Sparling A, Burns R. Modifying provider vitamin D screening behavior in primary care. J Am Board Fam Med 2020; 33(2): 252–261. https://doi.org/10.3122/jabfm.2020.02.190323
15. Zuberi LM, Habib A, Haque N, Jabbar A. Vitamin D Deficiency in ambulatory patients. J Pak Med Assoc 2008; 58(9): 482–484.
16. Essig S, Merlo C, Reich O, Trottmann M. Potentially inappropriate testing for vitamin D deficiency: a cross-sectional study in Switzerland. BMC Health Serv Res 2020; 20(1): 1097. http://doi.org/10.1186/s12913-020-05956-2
17. Woodford HJ, Barrett S, Pattman S. Vitamin D: too much testing and treating? Clin Med 2018; 18(3): 196–200. http://doi.org/10.7861/clinmedicine.18-3-196
18. Pludowski P, Takacs I, Boyanov M, Belaya Z, Diaconu CC, Mokhort T, et al. Clinical practice in the prevention, diagnosis and treatment of vitamin D deficiency: A central and eastern European expert consensus statement. Nutrients 2022; 14(7): 1483. http://dx.doi.org/10.3390/nu14071483