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Research Article

GENDER, AGE, AND BODY MASS INDEX INFLUENCES ON VITAMIN D CONCENTRATION AMONG ELDERLY IN INDIAN POPULATION.

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ABSTRACT

Vitamin D insufficiency prevalence has been related to low bone mineral density (BMD). However, controversial results have been reported for the relationship between serum 25-hydroxyvitamin D [25(OH)D] levels and BMD. This study was done to investigate whether serum 25(OH)D levels were associated with BMD in different age group and sex link population. This study involved, aged 40-70 yr, who is consecutively selected from KPCMCH, BMD camp. BMD was measured at the lumbar spine and femoral neck. The correlation between serum 25(OH)D levels and BMD was investigated. In this study, there is significant different between healthy and patients group in vitamin D3level.BMD significantly decreased in patients group more elderly. Further studies are needed to replicate these data in larger populations and to elucidate the mechanisms involved in this association. Also, it is necessary to take supplements especially for those who have low plasma 25(OH)D levels related to SNPsmarkers of inactivating enzymes and/or vitamin D binding protein.

Keywords:- Vitamin D, Gender, BMI, BMD

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INTRODUCTION

Vitamin D is considered essential for bone health. In some studies, vitamin D insufficiency has been reported to be associated with low bone mineral density (BMD) and increased bone loss (1,2). However, the results reported so far have been controversial (3, 4) Now Obesity is another rapidly growing health problem in most developed countries (2). During the last decade, the prevalence of obesity (body mass index (BMI) ≥30) increased dramatically. Vitamin D low levels negatively affect bone mineralization causing rickets in children and osteomalacia in adults [3,5]. In addition, vitamin D insufficiency is associated with other diseases; chronic kidney disease (CKD) gives rise to secondary hyperparathyroidism (SHPT) which can lead to loss of bone density and elevated rates of fracture in renal patients [6],common cancers [7], autoimmune disorders [8,9], multiple sclerosis [10], Cardiovascular disease [11], lung function, and asthma [12] Risk factor for fracture may be hypovitaminosis D, as established for the general population [11,13]. Vitamin D has an important effect on bone metabolism, which is formed in the epidermis or provided by the diet. Heike [12] showed a positive association between vitamin D status and BMD at the femoral neck. Compared with subjects with vitamin D deficiency, those with vitamin D insufficient subjects had a 7.3% higher BMD and vitamin D replete subjects had a 8.5% higher BMD. In addition, vitamin D deficiency may indirectly increase risk of diabetes progression by contributing to low bone density.

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Materials and Methods

Study Population.

In this cross-sectional study 100subject have been enrolled which was conducted in SLIMS,Pondicherry. Out of hundred subject: 40 subjects were apparently healthy and 60 subjects were selected as a patients after taking the history of inclusion criteria included : Multiple joint pain for prolong period in adult, Low back pain with kyphotic deformity in elderly age group, young patients with pain in long bones of lower limb, History of fracture with insignificant trauma.

Serum collection and analysis:

Blood samples (5 ml) were collected from each subject in the morning after an overnight fast. The blood was centrifuged for 15min at 2000 rpm. The serum was placed in Eppendorf tubes and stored at -80°C until further analysis.

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Vitamin D levels were classifed into 3 major groups [13, 14] as follows:

(1) Suficient (>30 ng/mL);
(2) Insuficient (20–30 ng/mL);
(3) Deficient (<20 ng/mL).

BMI measurements: women were divided into six and men into BMI groups: i) BMI <20 – underweight (only for women); ii) BMI 20-24.9 – normal weight; iii) BMI 25-29.9 –overweight; iv) BMI 30-34.9 – obesity, degree I; v) BMI 35-39.9 –obesity, degree II; vi) BMI ≥40 – super obese, obesity degree III [15]. Bone mineral density examination: BMD was determined using Dual Energy X-ray Absorptiometry (DEXA). Both spine region including lumbar vertebrae 1-4 and femoral neck area l BMD were obtained. To eliminate operator differences, all women were tested by the same operator during the study

Statistical Analysis:

Data from 100 subjects were expressed as mean ± SD and statistically analyzed using SPSS Version 16.0. Linear regression analysis was performed to assess correlations between BMI, serum 25(OH)D3 and 1,25(OH)2D3 levels, age and gender. P-values <0.05 were considered as indicating statistical signifcance.

Table 1: Demographics data (age and body mass index) of all participants (n = 100).

Parameter Healthy individuals	Healthy individuals (N=40) Mean ±SD	Patients (N= 60) Mean ±SD
Total		
Age (years)	55.68 ±10.12	55.99 ± 9.45
BMI (kg/m2)	28.69 ± 5.10	28.32 ± 5.32
Males		
Age (years)	55.86 ± 10.12	54.75 ± 9.32
BMI (kg/m2)	29.32 ± 5.10	27.68 ± 4.73
Females		
Age (years)	54.86 ± 10.32	58.83 ± 10.01
BMI (kg/m2)	28.32 ± 4.61	28.69 ± 5.32

Table 2: Mean value of vitamin D levels in ng/mL for 40 to 70 years of age in healthy and Patients at hospital.

Category	Healthy Vitamin D (ng/ml)	Patient Vitamin D (ng/ml)	P value
Total	30.78 ± 10.48 (N=40)	26.32 ± 8.92 (N=60)	< 0.0001
Total Males	33.28 ± 11.32 (N=16)	25.14 ± 8.12 (N=45)	< 0.0001
Total Females	29.65 ± 10.02 (N=24)	23.64 ± 7.86 (N=15)	0.0232
Normal BMI Weight	31.38 ± 9.52 (N=06)	27.75 ± 10.22 (N=14)	0.2221
Overweight	29.88 ± 9.52 (N=32)	24.57 ± 8.89 (N=22)	0.0089
Obese	26.66 ± 6.96 (N=15)	20.88 ± 6.29 (N=24)	0.0002
40-50 years	37.55 ± 9.28 (N=25)	26.92 ± 9.98 (N=25)	< 0.0001
51-60 years	31.27 ± 4.69 (N=13)	26.52 ± 6.48 (N=17)	0.0029
Over 60 years	22.81 ± 3.69 (N=09)	18.12 ± 7.32 (N=11)	0.0128

Significant (P value 0.050)

Discussion:

The finding of this study revealed that vitamin D levels are affected by many factors such as nationality, gender, sex, BMI, physical activity, and lifestyle and this was reported. Vitamin D is a fat soluble hormone that plays essential role in calcium homeostasis and

mineralization of bones [16]. Vitamin D is unique, in terms of its metabolism and physiologic features. Human dependence on both endogenous syntheses (activation through exposure to ultraviolet light) accounts for about 90% of vitamin D (vitamin D3) and exogenous sources (diet, primarily fortified foods) to meet biological requirements (vitamins D2 and D3) [17–19].

Vitamins D3 (cholecalciferol) and D2 (ergocalciferol) are metabolized in an identical manner in the liver to 25-hydroxyvitamin D [20], by the enzyme cytochrome P450 (vitamin D 25-hydroxylases) to 25-hydroxyvitamin D3, which is the most abundant form of vitamin D in the circulation. Further hydroxylation of 25-hydroxyvitamin D to 1, 25(OH) 2D (active vitamin D) by the 1α-hydroxylase enzyme occurs in the kidney [21].A circulation of approximately 10–15 days halflife of 25(OH)D [22]makes it the ideal measure for vitamin D, although the concentration of 25(OH)D in the serum was 8– 60 ng/mL or 20–150 nmol/L [22].

Many studies reported that vitamin D low levels negatively affect bone mineralization causing rickets in children and osteomalacia in adults [19, 23]. In addition, vitamin D insufficiency is associated with other diseases; chronic kidney disease (CKD) gives rise to secondary hyperparathyroidism (SHPT) which can lead to loss of bone density and elevated rates of fracture in renal patients [24], common cancers [18], autoimmune disorders [25,26], multiple sclerosis [27], cardiovascular disease [28], lung function, and asthma [29]. Also, epidemiological studies show that low blood levels of 25-hydroxyvitamin D (25(OH)D, a marker of vitamin D status), are linked with an increased risk of type 2 diabetes [29].

As vitamin D is a fat soluble hormone, thus adipose tissue might be a site of sequestration of vitamin D, storing and subsequently lowering circulating levels of 25(OH)D [16,18]. And because normal and overweight subjects have adipose tissue less than that of obese subjects, they might show elevation in the availability of vitamin D [30,31] and this is in accordance with the results revealed in this study.

The inverse relationship between circulating levels of 25(OH)D with risk biomarkers and high lipid profile was detected by many studies [32,33]. Herein, comparison between healthy and hyperlipidemic patients based on BMI was done and vitamin D mean level for the normal BMI healthy individuals and hyperlipidemic patients was also evaluated. Vitamin D level for the overweight BMI healthy individuals and that for hyperlipidemic patients was presented. These findings are consistent with Brock et al., who reported that body mass index (BMI) >30 kg/m2 is one of the major factors that affect vitamin D levels [34].

In addition, age is essential factor that affects vitamin D levels like obesity, gender, and diseases. Generally, elder people are susceptible to vitamin D deficiency due to many risk factors, not only due to reduced skin production of vitamin D with age but also due to decreased sunlight exposure, decreased dietary intake, reduced skin thickness, impaired intestinal absorption, and diminished hydroxylation in the liver and kidney [35,36]. The study finding revealed that vitamin D level was decreased with age in both healthy and hyperlipidemic patients as shown in Table 4 and it is interesting that for all age groups vitamin D mean levels were significantly higher in healthy compared to hyperlipidemic individuals. However, the incidence of vitamin D insufficiency and deficiency in Arab people is multifactorial involving gender, age, obesity, clothing, cultural behaviors, skin pigmentation, vitaminD, calcium supplements, sun exposure, and polymorphism of vitamin D receptors [37-40].

The Finding of this study revealed that vitamin D levels are affected by many factors such as nationality, gender, sex, BMI, physical activity, and lifestyle and this was reported previously [41-46]. The effect of BMI on serum 25(OH) D3 may be explained by the fact that persons with high BMI usually have a high content of body fat, acting as a reservoir for lipid-soluble vitamin D. It has previously been shown in animal models that body adipose tissue can accumulate about 10-12% of a supplemented dose of vitamin D [47)] At the same time, the release of vitamin D from the fat is extremely slow and proportional to the concentration of the vitamin in the adipose tissue [47]. This biological mechanism may have the purpose of pro tectingthe body from toxic effects of active forms of vitamin D and maintaining an optimal level in the blood. However, excess body fat results in its increased sequestration and low availability and, as a consequence, low serum 25(OH)D levels [47,48]. A large fraction of severely obese patients undergoing surgical treatment for obesity have hypovitaminosis D before surgery [49,50]. Surprisingly, however, serum levels of 25(OH)D do not increase significantly after surgery and weight loss, even if vitamin D supplements are administered . Nevertheless, the magnitude of weight loss is negatively correlated with serum 25(OH) D.

Conclusion:

In this study there is significant different between healthy and patients group in vitamin D3 level. BMD significantly decreased in patients group more elderly. There is significant correlation between vitamin D3 level and BMD at hip and spine. Male gender, BMI and age are significant predictor of BMD. Patients with higher BMI have significantly lower BMD. So, vitamin d3 level is adversely related with BMI. It suggests that Obesity adversely affects bone health and prone to bone fragility, bone pain and fractures. Overweight and obese BMI categories showed a significant difference between

healthy individuals and hyperlipidemic patients though; normal BMI category showed no significant difference between the two groups. In this study, vitamin D levels for healthy individuals were higher than vitamin D levels for hyperlipidemic patients in the three age categories. Hyperlipidemia is associated with decreased vitamin D concentrations through an unknown mechanism. Further studies are needed to replicate these data in larger populations and to elucidate the mechanisms involved in this association. Also, it is necessary to take supplements especially for those who have low plasma 25(OH) D levels related to SNP smarkers of inactivating enzymes and/or vitamin D binding protein**.**

REFERENCES

1. Narula R, Tauseef M, Ahmad IA, Agarwal K, Ashok A, Anjana A. Vitamin D deficiency among postmenopausal women with osteoporosis. J Clin Diagn Res 2013; 7 : 336-8.
2. Sadat-Ali M, Al Elq AH, Al-Turki HA, Al-Mulhim FA, Al-Ali AK. Influence of vitamin D levels on bone mineral density and osteoporosis. Ann Saudi Med 2011; 31 : 602-8.
3. Wat WZ, Leung JY, Tam S, Kung AW. Prevalence and impact of vitamin D insufficiency in southern Chinese adults. Ann Nutr Metab 2007; 51 : 59-64.
4. von Mühlen DG, Greendale GA, Garland CF, Wan L, Barrett-Connor E. Vitamin D parathyroid hormone levels and bone mineral density in community-dwelling older women: the Rancho Bernardo Study. Osteoporos Int 2005; 16 : 1721-6.
5. MF. Holick and T. C. Chen, "Vitamin D deficiency: a worldwide problemwith health consequences," The American Journal of Clinical Nutrition, vol. 87, no. 4, pp. 1080S -1086S, 2008.
6. AS. Dusso, "Kidney disease and vitamin D levels: 25-hydroxyvitamin D, 1,25- dihydroxyvitamin D, and VDR activation,"Kidney International Supplements, vol. 1, no. 4, pp. 136–141, 2011.
7. KC. Chiang, C.-N. Yeh, M.-F. Chen, and T. C. Chen, "Hepatocellular carcinoma and vitamin D: a review," Journal of Gastroenterology and Hepatology, vol. 26, no. 11, pp. 1597–1603,2011.
8. JJ. Cannell, R. Vieth, J. C. Umhau et al., "Epidemic infuenza and vitamin D," Epidemiology and Infection, vol. 134, no. 6, pp.1129–1140, 2006.
9. PT. Liu, S. Stenger, H. Li et al., "Toll-like receptor triggering of a vitamin D-mediated human antimicrobial response," Science, vol. 311, no. 5768, pp. 1770–1773, 2006.
10. G. Giovannoni and G. Ebers, "Multiple sclerosis: the environment and causation," Current Opinion in Neurology, vol. 20, no.3, pp. 261–268, 2007.
11. T. L. Larose, Y. Chen, C. A. Camargo Jr., A. Langhammer, P.Romundstad, and X.-M. Mai, "Factors associated with vitamin D de□ciency in a Norwegian population: the HUNT Study,"Journal of Epidemiology and Community Health, vol. 68, no. 2, pp. 165–170, 2014.
12. T. L. Larose, A. Langhammer, Y. Chen, C. A. Camargo Jr., P.Romundstad, and X. M. Mai, "Serum 25-hydroxyvitamin Dlevels and lung function in adults with asthma: the HUNT Study," The European Respiratory Journal, vol. 45, pp. 1019–1026,2015.
13. MF. Holick, N. C. Binkley, H. A. Bischoff-Ferrari et al.,"Evaluation, treatment, and prevention of vitaminD deficiency: an endocrine society clinical practice guideline," Journal of Clinical Endocrinology and Metabolism, vol. 96, no. 7, pp. 1911–1930, 2011.
14. C. Annweiler, G. Allali, P.Allain et al., "VitaminD and cognitive performance in adults: a systematic review," European Journal of Neurology, vol. 16, no. 10, pp. 1083–1089,2009.
15. AA Ginde, M. C. Liu, and C. A. Camargo Jr., "Demographic differences and trends of vitamin D insuf□ciency in the US population, 1988–2004," Archives of Internal Medicine, vol. 169,no. 6, pp. 626–632, 2009.
16. C. M. Weaver, "Vitamin D, calcium homeostasis, and skeleton accretion in children," *Journal of Bone andMineral Research*, vol. 22, supplement 2, pp. V45–V49, 2007.
17. S. Chakrabarty,H.Wang, L. Canaff, G. N.Hendy,H. Appelman, and J. Varani, "Calcium sensing receptor in human colon carcinoma: interaction with Ca2+ and 1,25-dihydroxyvitamin D3," *Cancer Research*, vol. 65, no. 2, pp. 493–498, 2005.
18. K.-C. Chiang, C.-N. Yeh, M.-F. Chen, and T. C. Chen, "Hepatocellular carcinoma and vitamin D: a review," *Journal of Gastroenterology and Hepatology*, vol. 26, no. 11, pp. 1597– 603, 2011.
19. M. F. Holick, "Medical progress: vitamin D deficiency," *New England Journal of Medicine*, vol. 357, no. 3, pp. 266–281, 2007.
20. J. G. Haddad Jr. and T. J. Hahn, "Natural and synthetic sources of circulating 25-hydroxyvitamin D in man," *Nature*, vol. 244,pp. 515–527, 1973.
21. M. Garg, J. S. Lubel, M. P. Sparrow, S. G. Holt, and P. R. Gibson, "Review article: vitamin D and inflammatory bowel disease established concepts and future directions," *Alimentary Pharmacology &Therapeutics*, vol. 36, no. 4, pp. 324–344, 2012.

22. G. Jones, "Pharmacokinetics of vitamin D toxicity," *American Journal of Clinical Nutrition*, vol. 88, no. 2, pp. 582S–586S, 2008.
23. M. F. Holick and T. C. Chen, "Vitamin D deficiency: a worldwide problemwith health consequences," *The American Journal of Clinical Nutrition*, vol. 87, no. 4, pp. 1080S–1086S, 2008.
24. A. S. Dusso, "Kidney disease and vitamin D levels: 25-hydroxyvitamin D, 1,25-dihydroxyvitamin D, and VDR activation," *Kidney International Supplements*, vol. 1, no. 4, pp. 136–141, 2011.
25. J. J. Cannell, R. Vieth, J. C. Umhau et al., "Epidemic influenza and vitamin D," *Epidemiology and Infection*, vol. 134, no. 6, pp. 1129–1140, 2006.
26. P. T. Liu, S. Stenger, H. Li et al., "Toll-like receptor triggering of a vitamin D-mediated human antimicrobial response," *Science*, vol. 311, no. 5768, pp. 1770–1773, 2006.
27. G. Giovannoni and G. Ebers, "Multiple sclerosis: the environment and causation," *Current Opinion in Neurology*, vol. 20, no. 3, pp. 261–268, 2007.
28. T. L. Larose, Y. Chen, C. A. Camargo Jr., A. Langhammer, P. Romundstad, and X.-M. Mai, "Factors associated with vitamin D deficiency in a Norwegian population: the HUNT Study," *Journal of Epidemiology and Community Health*, vol. 68, no. 2, pp. 165–170, 2014.
29. 29. T. L. Larose, A. Langhammer, Y. Chen, C. A. Camargo Jr., P. Romundstad, and X. M. Mai, "Serum 25-hydroxyvitamin D levels and lung function in adults with asthma: the HUNT Study," *The European Respiratory Journal*, vol. 45, pp. 1019–1026, 2015.
30. A. Poobalan, L. Aucott, W. C. S. Smith et al., "Effects of weight loss in overweight/obese individuals and long-termlipid outcomes—a systematic review," *Obesity Reviews*, vol. 5, no. 1,pp. 43–50, 2004.
31. C. L. Rock, J. A. Emond, S. W. Flatt et al., "Weight loss is associated with increased serum 25-hydroxyvitamin D in overweight or obese women," *Obesity*, vol. 20, no. 11, pp. 2296-2301, 2012.
32. K. Y. Z. Forrest and W. L. Stuhldreher, "Prevalence and correlates of vitamin D deficiency in US adults," *Nutrition Research*, vol. 31, no. 1, pp. 48–54, 2011.
33. D. H. Kim, S. Sabour, U. N. Sagar, S. Adams, and D. J.Whellan, "Prevalence of Hypovitaminosis D in Cardiovascular Diseases (from the National Health and Nutrition Examination Survey 2001 to 2004),"*The American Journal of Cardiology*, vol. 102, no. 11, pp. 1540–1544, 2008.
34. K. Brock, R. Cant, L. Clemson, R. S. Mason, and D. R. Fraser, "Effects of diet and exercise on plasma vitamin D (25(OH)D) levels in Vietnamese immigrant elderly in Sydney, Australia,"
35. *The Journal of Steroid Biochemistry and Molecular Biology*, vol. 103, no. 3–5, pp. 786–792, 2007.
36. D. D. Bikle, "Vitamin D insufficiency/deficiency in gastrointestinal disorders," *Journal of Bone and Mineral Research*, vol. 22, no. 2, pp. V50–V54, 2007.
37. M. Gasscon-Barre, "The vitamin D 25-hydroxylase," in *Vitamin D*, D. Feldman, J. W. Pike, and F. H. Glorieux, Eds., pp. 47–68,ElsevierAcademic Press, Boston,Mass, USA, 2nd edition, 2005.
38. S. Al-Musharaf, A. Al-Othman,N. M. Al-Daghri et al., "Vitamin D deficiency and calcium intake in reference to increased body mass index in children and adolescents," *European Journal of Pediatrics*, vol. 171, no. 7, pp. 1081–1086, 2012.
39. M. Y. Elsammak, A. A. Al-Wosaibi, A. Al-Howeish, and J. Alsaeed, "Vitamin D deficiency in Saudi Arabs," *Hormone and Metabolic Research*, vol. 42, no. 5, pp. 364–368, 2010.
40. F. L. Weng, J. Shults, M. B. Leonard, V. A. Stallings, and B. S. Zemel, "Risk factors for low serum 25-hydroxyvitamin D concentrations in otherwise healthy children and adolescents," *TheAmerican Journal of ClinicalNutrition*, vol. 86,no. 1, pp. 150-158, 2007.
41. R. J.Wood and J. C. Fleet, "Thegenetics of osteoporosis: vitamin Dreceptor polymorphisms," *Annual Review ofNutrition*, vol. 18, pp. 233–258, 1998.
42. N. M. Al-Daghri, K. M. Alkharfy, A. Al-Othman et al., "Effect of gender, season, and vitamin D status on bone biochemical markers in Saudi diabetes patients," Molecules, vol. 17, no. 7, pp. 8408–8418, 2012.
43. A. Al-Othman, S. Al-Musharaf, N. M. Al-Daghri et al., "Effect of physical activity andsun exposure on vitamin D status of Saudi children and adolescents," BMC Pediatrics, vol. 12, article 92, 2012.
44. A. Al-Othman, S. Al-Musharaf,N. M. Al-Daghri et al., "Tea and coffee consumption in relation to vitamin D and calcium levels in Saudi adolescents," Nutrition Journal, vol. 11, no. 1, article 56, 2012.
45. B.Hamilton, J.Grantham, S. Racinais, and H.Chalabi, "Vitamin D de□ciency is endemic in Middle Eastern sportsmen," Public Health Nutrition, vol. 13, no. 10, pp. 1528–1534, 2010.
46. NA Meguid, A. F. Hashish, M. Anwar, and G. Sidhom, "Reduced serum levels of 25- hydroxy and 1,25-dihydroxy vitamin D in Egyptian children with autism," Journal of Alternative and Complementary Medicine, vol. 16, no. 6, pp. 641–645, 2010.

47. S. Racinais, B. Hamilton, C. K. Li, and J. Grantham, "Vitamin D and physical fitness in Qatari girls," Archives of Disease in Childhood, vol. 95, no. 10, pp. 854–865, 2010.
48. Rosenstreich SJ, Rich C and Volwiler W: Deposition in and release of vitamin D3 from body fat: evidence for a storage site in the rat. J Clin Invest 50: 679-687, 1971.
49. Wortsman J, Matsuoka LY, Chen TC, Lu Z and Holick MF: Decreased bioavailability of vitamin D in obesity. Am J Clin Nutr 72: 690-693, 2000.
50. Abbasi AA, Amin M, Smiertka JK, Grunberger G, MacPherson B, Hares M, Lutrzykowski M and Najar A: Abnormalities of vitamin D and calcium metabolism after surgical treatment of morbid obesity: a study of 136 patients. Endocr Pract 13: 131-136, 2007.
51. Carlin AM, Rao DS, Meslemani AM, Genaw JA, Parikh NJ, Levy S, Bhan A and Talpos GB: Prevalence of vitamin D depletion among morbidly obese patients seeking gastric bypass surgery. Surg Obes Relat Dis 2: 98-103, 2006.