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Exploring the Relationship Between Age and Vitamin D-3 Deficiency in Orthopedic Disorder Patients: A Comprehensive Analysis

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ABSTRACT

Numerous investigations have proposed a robust association between 25-hydroxyvitamin D or vitamin D levels and overall well-being, demonstrating effects spanning mental health, vital organ function and musculoskeletal health. This study aims to evaluate vitamin D deficiency across diverse age groups and genders, with a specific focus on low levels of vitamin D-3, aiming to mitigate the escalating public health concern associated with severe vitamin D shortage. This retrospective observational study patient medical records, encompassing various orthopedic conditions and spanning all age groups and genders, were scrutinized. The dataset of 567 patients was analyzed to investigate the correlation between vitamin D-3 levels and different age categories. Vitamin D insufficiency was categorized as minor (25-OHD 20-30 ng mL^{-1}), while moderate and severe deficiencies were classified as less than 20 ng mL^{-1}. The study encompassed 184 men (32.45%) and 383 women (67.55%). Vitamin D deficiency (20 ng mL^{-1}) was observed in 64.37% of patients, while 17.99% exhibited levels between 20 and 30 ng mL^{-1} and 17.64% had adequate levels. Notably, individuals in the 31-40 age group displayed a higher prevalence of vitamin D deficiency, with 25% exhibiting insufficiency. Despite the susceptibility of individuals of all age groups to vitamin D insufficiency, those aged 31-40 demonstrated the highest vulnerability. Additionally, women exhibited a greater predisposition to hypovitaminosis D compared to men. The findings underscore the imperative for healthcare professionals to collaboratively enhance public awareness of vitamin D deficiency, particularly among individuals in the specified age groups.

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Key Words
Age, gender, vitamin D, orthopedic disorder

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INTRODUCTION

For the overall well-being of individuals spanning various age groups, vitamin D, also referred to as 25-hydroxyvitamin D [25(OH)D], stands as a crucial fat-soluble vitamin governing calcium homeostasis. Synthesized endogenously through exposure of the skin to ultraviolet rays from sunlight, it is naturally found in numerous foods and dietary supplements. The key indicator of vitamin D levels, 25(OH)D, is considered insufficient for general health and welfare in adults when the blood concentration falls below 30 nmol L^{-1}[1-3].

Historically labelled as the "sunlight vitamin" or the "anti-rickets factor," vitamin D plays a vital role in maintaining calcium homeostasis and is essential for processes such as normal bone mineralization, muscular contraction and nerve impulse transmission. Prolonged vitamin D insufficiency is associated with various conditions, including gout, ankylosing spondylitis, osteoporosis, osteomalacia, muscle weakness, osteoarthritis, generalized body aches, and an increased risk of falls. Despite the prevalence of vitamin D deficiency, current evidence is insufficient to recommend widespread vitamin D supplementation. A clear correlation exists between vitamin D insufficiency and several health outcomes, including all-cause mortality[4-7].

Beyond its association with cancer, autoimmune and infectious diseases, hypertension, diabetes and metabolic syndrome, vitamin D is indispensable for bone health and the prevention of falls and fractures [8]. The aging process affects vitamin D and calcium metabolism through mechanisms such as reduced calcium absorption, intestinal resistance to circulating 1,25(OH)2D, diminished vitamin D receptors, decreased renal production of 1,25 (OH)2D by the aging kidney, decreased skin production of vitamin D and substrate deficiency of vitamin D[8-10].

Our study aims to assess vitamin D deficiency across diverse age groups and genders, with a particular focus on low levels of vitamin D-3. This emphasis seeks to address the growing public health concern associated with severe vitamin D shortage.

MATERIAL AND METHODS

This inquiry took the form of an observational, retrospective study. The medical records of individuals afflicted with orthopedic ailments, encompassing a diverse age range and both genders, were meticulously scrutinized during their hospitalization. The dataset under scrutiny comprised information from 567 patients to assess the correlation between vitamin D-3 levels and various age brackets.

A predefined scale, adopted from pertinent literature and elucidated in the ensuing passage, guided our categorization of instances into mild, moderate and severe groupings. In accordance with this classification, a minor deficiency in vitamin D is denoted as insufficiency (25-OHD 20-30 ng mL^{-1}), while moderate and severe deficiencies are classified as deficiency (25-OHD 20 ng mL^{-1})[11]. Statistical analysis involved the compilation and input of gathered data using Microsoft Excel 2013. Subsequently, the data was exported to the data editor page of SPSS version 20 for in-depth analysis. The significance level and confidence level for each conducted test were established at 5% and 95%, respectively.

RESULTS

The investigation encompassed the scrutiny of records from 567 patients throughout the study duration. Among these, 184 individuals (32.45%) were male, while 383 individuals (67.55%) were female, as delineated in Table 1. Notably, 365 patients (64.37%) exhibited vitamin D deficiency (<20 ng mL^{-1}), whereas 102 patients (17.99%) manifested levels within the 20-30 ng mL^{-1} range and 100 patients (17.64%) demonstrated sufficient vitamin D levels, as detailed in Table 2 and illustrated in Fig. 1.

In the context of age stratification, individuals aged 31-40 exhibited a higher prevalence of vitamin D deficiency compared to other age cohorts. Specifically, a quarter (25%) of patients in the 31-40 year age bracket presented with vitamin D insufficiency. Importantly, the observed disparity in vitamin D levels among distinct age groups was determined to be statistically significant.

Fig. 1: Vitamin D Deficiency in study population

Table 1: Distribution of study participants based on gender

Gender	No.	Percentage
Male	184	32.45
Female	383	67.55
Total	567	100.00

Table 2: Patient distribution according to vitamin D deficiency

Vitamin D Levels (ng mL^{-1})	No.	Percentage
<20	365	64.37
20-30	102	17.99
>30	100	17.64
Total	567	100.00

DISCUSSIONS

In India, there is a widespread prevalence of vitamin D insufficiency. Several investigations have underscored the low levels of vitamin D observed in various demographic groups, including young individuals, hospital staff, postmenopausal women, and schoolchildren. Our research reveals a significant incidence of vitamin D insufficiency among inpatients in the orthopaedic department of hospitals. The prevalence of vitamin D deficiency and insufficiency in our study was identified as 61% and 18%, respectively, based on the classification adopted from existing literature Hashemipour *et al*.[12,13] reported that in the general population, severe, moderate, and mild vitamin D deficiencies occurred at frequencies of 9.5-57.6% and 14.2%, respectively, resulting in an overall deficiency rate of 67%, aligning with our study [14]. Notably, patients in India experiencing low back pain exhibited an approximately 50% prevalence of vitamin D deficiency, consistent with our findings[15].

Our results indicate that individuals aged 31-40 years, particularly females, exhibited a higher prevalence of vitamin D deficit. While only a limited number of studies confirm the association between female gender and vitamin D insufficiency[16,17], additional literature suggests that vitamin D deficiency is often more prevalent in older individuals. Similar to earlier investigations, our study identified a substantial correlation between vitamin D levels and the extent of skin exposed to sunlight and the duration of exposure[18-20]. In the local community, significant contributing factors included religious practices necessitating the covering of the entire body or, for female subjects, exposing only the face and hands when outdoors due to concerns about skin tanning. The potential health repercussions could be considerable if a larger proportion of young individuals experience this deficiency, posing a significant negative impact on the nation’s economy.

The synthesis of vitamin D, often referred to as the "sunshine vitamin," has been occurring for over half a billion years. Previtamin D3 isomerizes into vitamin D3 in the body upon exposure to sunlight, absorbing ultraviolet B (UVB) radiation from 7-dehydrocholesterol. In addition to UVB radiation absorption, both previtamin D3 and vitamin D3 undergo transformation into various photoproducts, some of which possess distinct biological characteristics. Various prehistoric and historical perspectives shed light on the synthesis of vitamin D and its connection to sunlight. According to a study, obtaining vitamin D from sunlight is preferable to relying on supplements[21,22].

Considering that young adults form the backbone of the nation’s economic stability, addressing this escalating health crisis requires collaborative efforts among health institutions to identify the most effective measures for enhancing the population's health.

CONCLUSION

While individuals across all age groups face the potential for vitamin D insufficiency the agebracket of 31-40 emerges as particularly susceptible. Furthermore, women exhibit a greater predisposition to develop hypovitaminosis D in comparison to men. Given the implications of vitamin D deficiency, healthcare practitioners should collaborate diligently to enhance public awareness regarding this condition.

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