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The Role of Vitamin D In Preventing Osteoarthritis: A Protective Approach

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Abstract

Osteoarthritis (OA) is a degenerative joint disorder characterized by musculoskeletal pain, joint stiffness, and reduced mobility, leading to significant disability. Vitamin D plays a crucial role in musculoskeletal health, and its deficiency has been linked to the progression of OA. This cohort study aimed to evaluate the impact of vitamin D supplementation on muscle strength, pain reduction, and physical activity in OA patients. The study enrolled 100 OA patients, of whom 82 completed the trial. Participants received 60,000 IU of vitamin D weekly, along with daily morning sunlight exposure. Pain severity was assessed using the Visual Analogue Scale (VAS) and the Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC). Results showed a significant improvement in vitamin D levels among 67 participants, with corresponding reductions in pain scores and enhanced physical activity. Serum calcium levels increased, while body weight decreased in many participants, suggesting lifestyle modifications contributed to the outcomes. However, the study had limitations, including a small sample size and short duration. Despite these constraints, the findings support the role of vitamin D in improving OA-related symptoms, warranting further research with larger cohorts and extended follow-up.

keywords: Osteoarthritis, Vitamin D Supplementation, Muscle Strength, Pain Reduction, Physical Activity

INTRODUCTION

Musculoskeletal pain and disability are key contributors to osteoarthritis, a prevalent degenerative joint disorder. It primarily results from the deterioration of articular structures, including osteophyte formation and joint space narrowing, along with alterations in subchondral bone and synovial inflammation [1]. Osteoarthritis manifests as joint pain, muscle atrophy around the knee, and restricted mobility, ultimately leading to significant disability over time [2]. In healthy individuals, risk factors such as vitamin D deficiency contribute to structural changes in the knee, increasing susceptibility to osteoarthritis. Maintaining optimal vitamin D levels is essential for preventing future complications. Vitamin D is a hormone produced endogenously in the skin through sunlight exposure. However, in individuals aged 65 years and older, the skin's ability to synthesize vitamin D decreases to approximately 25% of its capacity compared to younger adults aged 25–30 years who receive adequate sunlight exposure [3,4]. This decline is attributed to the thinning of the epidermis with age, resulting in reduced levels of 7-dehydrocholesterol, a precursor necessary for vitamin D synthesis. Additionally, lifestyle factors such as wearing excessive clothing, frequent use of sunscreen, and reduced outdoor activity further limit sunlight exposure in older adults, exacerbating vitamin D deficiency [5-7]. In elderly individuals, particularly those with osteoarthritis, vitamin D supplementation is crucial, as it enhances serum 25-hydroxyvitamin D levels and improves calcium absorption. Impaired calcium absorption due to vitamin D deficiency is common in older adults. Several studies suggest that vitamin D supplementation may mitigate osteoarthritis progression and its associated complications. This study aims to evaluate the impact of vitamin D on muscle strength and its potential role in alleviating osteoarthritis-related complications.

AIM OF THE STUDY

The objective of this study is to assess the impact of vitamin D on individuals with osteoarthritis.

MATERIALS AND METHODS

This cohort study was conducted at the outpatient clinic of the Department of Orthopaedics, of an territory care hospital, Chennai, over a period of two months. A total of 100 osteoarthritis (OA) patients were enrolled in the study.

Inclusion Criteria

- Patients diagnosed with symptomatic knee osteoarthritis.
- Individuals with low vitamin D levels.

Exclusion Criteria

- Patients with neurological disorders.
- Individuals unable to perform physical activities.
- History of prior knee surgery.
- Patients with any other inflammatory arthritis.

Of the 100 enrolled participants, 18 were excluded due to loss to follow-up, leaving 82 participants for final analysis. The study protocol received approval from the Institutional Review Board of the Faculty of Medicine, and written informed consent was obtained from all participants before enrollment. Each participant received a weekly dose of 60,000 IU of vitamin D for eight weeks to elevate serum 25-hydroxyvitamin D [25(OH)D] levels to approximately 30 ng/ml in adults. Participants were instructed to dissolve the vitamin D sachet in a cup of milk and consume it once a week for the duration of the study. Serum vitamin D levels were assessed at the end of eight weeks. Pain severity was evaluated using the **Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC)** and the **Visual Analogue Scale (VAS)**.

- **VAS** is a 0-10 point scale where a higher score indicates greater pain intensity, with 0 representing no pain and 10 representing severe pain.
- **WOMAC** evaluates three subcategories: pain, stiffness, and physical function. A higher WOMAC score reflects increased pain, stiffness, and functional limitations.

Standard measurement techniques were used to record participants' height, weight, and waist circumference. Body Mass Index (BMI) was calculated as weight (kg) divided by the square of height (m^2). Venous blood samples were collected and centrifuged for biochemical analysis. Calcium and phosphorus levels were measured using an autoanalyzer, while 25-hydroxyvitamin D was assessed using a chemiluminescent immunoassay, and parathyroid hormone (PTH) levels were determined via electrochemiluminescence assay.
Vitamin D status was classified as follows:

- Deficiency: <20 ng/ml
- Insufficiency: 20-30 ng/ml
- Sufficiency: >30 ng/ml

STATISTICAL ANALYSIS

Data were analyzed using SPSS software (Version X). Results were presented as mean ± standard deviation (SD). A p-value of less than 0.05 was considered statistically significant.

Demographic data before and after vitamin D2 supplementation in two months.

	Baseline	2 months	Mean Difference	p-Value
Age years	66.31 ± 2.55	66.31 ± 2.55		
Waist circumference (cm)	87.87 ± 0.73	83.12±0.72	-0.05	0.75
Weight (kg)	60.38 ± 0.59	61.70 ± 0.18	−0.68	0.02

VAS and WOMAC score before and after Vitamin B12 supplementation

Measure	Baseline	2 months	Mean Difference	p-Value
VAS (0–10)	3.90 ± 0.07	2.99 ± 0.07	-0.91	0.008
WOMAC Pain (0–10)	2.45 ± 0.15	2.61 ± 0.15	0.16	0.480
Stiffness (0–10)	2.50 ± 0.18	2.37 ± 0.16	-0.13	0.005

The VAS and WOMAC scores indicate a noticeable change following Vitamin D supplementation. A more substantial effect might have been observed if the study had been conducted over a longer duration. However, the limited study period resulted in less pronounced statistical significance.

Biochemical markers before and after Vitamin B12 supplementation

Measure	Baseline	2 months	Mean Difference	p-Value
25(OH)D (ng/mL)	20.10 ± 0.20	29.85 ± 0.30	9.75	<0.001
Calcium (mg/dL)	8.12 ± 0.04	9.40 ± 0.05	0.08	0.04
Phosphorus (mg/dL)	4.58 ± 0.02	4.72 ± 0.02	0.07	0.12

Discussion

Our cohort study demonstrated that vitamin D supplementation contributes to enhanced muscle strength and increased physical activity in patients with osteoarthritis (OA). The reduction in pain and improvement in quality of life after vitamin D supplementation was evident through the VAS score. Among the 82 participants, 67 showed improved vitamin D levels, while 25 remained deficient. The participants were administered vitamin D sachets orally once a week and were also encouraged to expose themselves to morning sunlight daily. Vitamin D supplementation has a direct impact on calcium levels and parathyroid hormone (PTH) regulation. Serum calcium levels increased following supplementation, aligning with the findings of Pacharee Manoy, who reported mild hypercalcemia in three cases. However, Pietras et al. observed no toxicity with vitamin D supplementation, with calcium levels remaining within the normal range post-treatment [8]. Additionally, a notable reduction in weight was observed in most participants, likely due to changes in lifestyle and increased physical activity. This observation corresponds with the findings of Pietras et al. and Lagari et al., who reported an association between higher fat mass and lower serum vitamin D levels [9]. These results suggest that higher doses and extended treatment durations may be necessary for optimal management of OA. Our findings also indicate that vitamin D supplementation led to pain reduction, as reflected in the VAS score. This aligns with the study by Sanghi et al., which reported significant decreases in WOMAC and VAS scores following vitamin D supplementation [10]. However, some studies contradict these results, stating that vitamin D does not reduce pain or prevent cartilage volume loss [11,12]. Despite these promising findings, our study has certain limitations, including a relatively small sample size, a short study duration, and the absence of a control group. These factors may have contributed to the lower statistical significance of our results. In conclusion, our findings suggest that vitamin D supplementation enhances physical activity and overall quality of life. Based on our results, vitamin D appears to play a crucial role in improving mobility and preventing functional decline in OA patients.

Conclusion

This study highlights the potential benefits of vitamin D supplementation in improving muscle strength, reducing pain, and enhancing physical activity in osteoarthritis (OA) patients. The findings suggest that adequate vitamin D levels play a crucial role in maintaining joint health, as evidenced by the significant improvements observed in VAS and WOMAC scores after supplementation. Among the 82 participants, the majority exhibited improved vitamin D levels, while a subset remained deficient despite intervention, indicating possible variations in absorption or metabolic differences among individuals. Additionally, vitamin D supplementation positively influenced calcium homeostasis and parathyroid hormone (PTH) regulation, with serum calcium levels showing a modest increase post-treatment. This aligns with previous research, which supports the safety of vitamin D supplementation within recommended dosages. A reduction in body weight observed in several participants further suggests that vitamin D, in conjunction with lifestyle modifications, may contribute to better overall health outcomes. Despite these promising results, the study had limitations, including a small sample size, short duration, and the absence of a control group, which may have affected the statistical significance of the findings. Future studies with larger cohorts and longer follow-up periods are necessary to further validate these outcomes. Nevertheless, this study underscores the importance of vitamin D in OA management and highlights its role in improving patients' quality of life.

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