Research Article

# Effect of Vitamin D supplement in improving pain, sleep, and quality of life on patients with chronic low back pain

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## ABSTRACT

**Objectives:** The objectives of the study were to assess the intensity of pain in patients before Vitamin D supplements and post supplements, and to identify a therapy that reduces pain and improves the quality of life (QOL) of patients with minimal or no adverse effects. **Materials and Methods:** The patients enrolled in the study were assessed for their pain, sleep, and QOL using widely accepted testing categories such as visual analogue scale and numerical rating scale for pain, pittsburgh sleep quality index (PSQI) for sleep, and World Health Organization Quality of Life Instruments for QOL. The testing for improvement in pain, sleep, and QOL was assessed at baseline (before Vitamin D supplements) and monitored post Vitamin D supplements. The testing was assessed 2 times–at baseline and after 8 weeks. The improvement in pain, sleep, and QOL was determined by comparing the scores obtained by the individual from the two intervals. **Results:** The study included 40 patients in which all were cases diagnosed with chronic low back pain (CLBP). Among 40 patients, with ages 36–45 years are at maximum affected by CLBP. Among the 40 patients, 24 patients (60%) are male and 16 patients (40%) are females. From the parameters, 90% of the patients were free from social habits. When LBP, QOL, and sleep quality of the patients were studied using questionnaires, before and after the administration of Vitamin D supplementation. When QOL was compared, after treatment phase showed positive results. QOL was statistically significant between the phase ($P < 0.006$). **Conclusion:** Vitamin D supplementation has shown improvement in LBP by exerting immunological influences, thus decrement in pain is noted. The main mechanism through which Vitamin D supplementation reduces pain is its influences in the pain pathway by decreasing pro-inflammatory cytokines and increasing anti-inflammatory cytokines. Vitamin D supplementation thereby decreasing the pain increases the sleep and QOL of the patients with LBP.


**KEY WORDS:** Pain, Quality of life, Sleep, Vitamin D

## INTRODUCTION

Chronic low back pain (CLBP) is the most common pain complaint, second only to headache. CLBP is often progressive and the cause may be difficult to ascertain.[1,2] Chronic pain a common condition has a prevalence of up to 40% and is defined as any pain that is persisting beyond normal tissue healing time, usually lasting >12 weeks. Despite the availability of many pharmacological and invasive methods of treatment, many patients still suffer from morbidity. LBP is an important health problem in terms of low quality of life (QOL) improper sleep and loss of work power.[3,4]

Vitamin D, one of the vitamins of fat-soluble vitamins, is a group of sterols which are hormones and precursors because it can also be synthesized endogenously. Vitamin D plays an important role in promoting good bone and muscle health.[5] Vitamin D also operates to reduce inflammation, modulate cell growth, and influence neuromuscular systems and is of great physiological importance. Individuals with chronic pain may be at increased risk of Vitamin D deficiency, and steroids used to treat pain can reduce Vitamin D levels. All patients with persistent, musculoskeletal pain are at high risk of unrecognized and untreated Vitamin D deficiency. Current clinical guidelines for managing CLBP should include appropriate supplementation of Vitamin D, as this affects the QOL of the patient due to altered sleep and persistent pain preventing the individual from performing daily activities.[6,3]

The type of pain may vary greatly and may be felt as bone pain, nerve pain, or muscle pain. The sensation of pain may also vary. For instance, pain may be ache, burning, stabbing or tingling, sharp or dull, and well-defined or vague.[1,7] The intensity may range

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from mild to severe. A number of different theories have developed to try to explain chronic pain, but the exact mechanism is not completely understood. In general, it is believed that the nerve pathways that carry the pain signals from the nerve endings through the spinal cord and to the brain may become sensitized. Sensitization of these pathways may increase the frequency or intensity with which pain is perceived.[2]

The lower back where most back pain occurs includes the five vertebrae (referred to as L1-L5) in the lumbar region, which supports much of the weight of the upper body.[8] The spaces between the vertebrae are maintained by round; rubbery pads called intervertebral discs that act like shock absorbers throughout the spinal column to cushion the bones as the body moves. Bands of tissue known as ligaments hold the vertebrae in place, and tendons attach the muscles to the spinal column. Thirty-one pairs of nerves are rooted in the spinal cord and they control body movements and transmit signals from the body to the brain.[9] Vitamin D supplements cause increased absorption of calcium in bones thereby causing increased serum Vitamin D levels, which strength the bone and muscles. Vitamin D plays a major role in improving LBP by reducing pro-inflammatory cytokines that cause inflammation and increases anti-inflammatory cytokines, which in turn reduces pain gradually.

Since Vitamin D deficiency is primarily responsible for increased LBP though other etiology contributes to persistent pain. Vitamin-D plays a key role in the etiology and progression of various chronic pain conditions and associated comorbidities by exerting anatomic, hormonal, neurological, and immunological influences on pain expression.[4,10]

Vitamin-D deficiency induces muscle weakness and pain in adults as well as children. Vitamin D has also shown immunomodulatory actions. Improvement in bone density and musculoskeletal symptoms is associated with Vitamin-D supplementation.

Its supplementation could reduce the synthesis of inflammatory cytokines and increase the anti-inflammatory cytokines. Vitamin-D deficiency can affect patients of all ages and might be an underlying factor in undiagnosed musculoskeletal pain. It is a potentially treatable problem and supplementation can be an adjuvant therapy for musculoskeletal pain.[8,9] Anatomical and the functional colocalization of central serotonergic, noradrenergic, and dopaminergic systems involved in pain, sleep, Vitamin D, and depression also tend to point to some interconnectivity. The enzyme one alpha-hydroxylase which converts 25-OHD to the active Vitamin D is present in the hypothalamus, cerebellum, and substantia nigra, areas that are also associated with depression.[4,3] VDRs are widespread in the human central nervous system, including neurons and glia in many areas of the cingulated cortex and hippocampus, which have been implicated in the pathophysiology of depression.

Vitamin D receptors are also present in the anterior and posterior hypothalamus, substantia nigra, midbrain periaqueductal gray, raphe nuclei, and the nuclei reticularis pontis oralis and caudalis. These same areas play a role in the initiation and maintenance of sleep. Vitamin D's effects on these brain areas may be linked to sleep modulation.[6,5]

## MATERIALS AND METHODS

Patients with CLBP pain and those who meet the inclusion study criteria were enrolled in the study. Patient's complete medication chart was recorded during the study. Written consent was obtained from those patients who are willing to participate in the study. The patients enrolled in the study were assessed for their pain, sleep, and QOL using widely accepted testing categories such as visual analogue scale and numerical rating scale for pain, PSQI for sleep, and World Health Organization Quality of Life Instruments for QOL. The testing for improvement in pain, sleep, and QOL was assessed at baseline (before Vitamin D supplements) and monitored post Vitamin D supplements. The testing was assessed 2 times– at baseline and after 8 weeks. The improvement in pain, sleep, and QOL was determined by comparing the scores obtained by the individual from the two intervals. All statistical analysis was carried out using GraphPad prism 7. Descriptive summary statistics were presented either as mean (SD) or median (minimum, and maximum), and choice of inferential statistical method will depend on the distribution type as determined through P-P plot 95% confidence interval will be maintained to minimize error. The assessment of pain, sleep, and QOL before and after Vitamin D supplementation was compared and analyzed using student's dependent *t*-test.

## RESULTS

The study included 40 patients in which all were cases diagnosed with CLBP. Among the 40 patients, there were 6 patients with age of 25–35 years (15%), 14 patients with from age of 36 to 45 years (35%), 12 patients at age 46–55 years (30%), and 8 patients around 56–65 years (20%). From the population with age of 36–45 years are at maximum affected by CLBP. Among the 40 patients, 24 patients (60%) are male and 16 patients (40%) are females. Various social habits of the patients among which 4 patients were smokers (10%), 36 patients nonsmokers (90%), 7 patients were alcoholics (17.5), and 33 patients nonalcoholics (82.5). From the above parameters, 90% of the patients

**Table 1: Distribution based on age**

| Age | No. of patients | Percentage of patients |
|---|---|---|
| 25–35 | 6 | 15 |
| 36–45 | 14 | 35 |
| 46–55 | 12 | 30 |
| 56–65 | 8 | 20 |

**Table 2: Distribution based on gender**

| Gender | No. of patients ($n$=40) | Percentage of patients |
|---|---|---|
| Male | 24 | 60 |
| Female | 16 | 40 |

**Table 3: Social habits**

| Social habits | No. of patients | Percentage of patients |
|---|---|---|
| Smoker | 4 | 10 |
| Non-smoker | 36 | 90 |
| Alcoholic | 7 | 17.5 |
| Non-alcoholic | 33 | 82.5 |

**Table 4: Comorbid conditions**

| Comorbidities | No. of patients | Percentage of patients |
|---|---|---|
| Hypertension | 6 | 15 |
| Diabetes mellitus | 11 | 27.5 |

**Table 5: Analysis of characteristic differences before and after Vitamin D supplement**

| Characteristics | *t*-test | C-I | *P* |
|---|---|---|---|
| LBP | 3.166 | 2.9609–15.483 | 0.002 |
| Sleep quality | 2.965 | 1.8312–6.8341 | 0.004 |
| QOL | 1.867 | 1.3505–4.3217 | 0.006 |

LBP: Low back pain, QOL: Quality of life

were free from social habits. The two main comorbid conditions of the patients were 6 patients (15%) have hypertension and 11 patients (27.5%) have diabetes mellitus. After analyzing between the two intervals of pain, sleep, and QOL testing, there was statistically a positive significance observed in improvement of pain, sleep, and QOL after Vitamin D supplements. When LBP, QOL, and sleep quality of the patients were studied using questionnaires, before and after the administration of Vitamin D supplementation. The mean pain of patients before Vitamin D was (7.97), and after treatment was (5.77), there was a statistical significance in the improvement in the pain ($P < 0.002$). When QOL was compared, after treatment phase showed positive results. QOL was statistically significant between the phase ($P < 0.006$).

## CONCLUSION

Chronic pain a common condition leading to complex anatomical changes where the etiology and management become a challenge. The most common chronic pain affecting majority of the population is LBP. Most of the cases Vitamin D plays an important role in the above manifestation. Vitamin D levels may exert anatomic and immunologic influences on pain manifestation. Vitamin D deficiency is seen associated with higher risk of chronic pain. Vitamin D supplementation has shown improvement in LBP by exerting immunological influences, thus decrement in pain is noted. Vitamin D supplements are widely available as it is inexpensive making it an appealing alternative and complementary treatment for chronic pain (LBP). The main mechanism through which Vitamin D supplementation reduces pain is its influences in pain pathway by decreasing pro-inflammatory cytokines and increasing anti-inflammatory cytokines. Hence, this study highly focuses on the benefit of Vitamin D supplementation and reduction of pain (LBP). It may help in further nutritional and supplemental support in patients with LBP. Vitamin D supplementation thereby decreasing the pain increases the sleep and QOL of the patients with LBP.

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