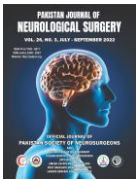

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Original Article

# Assessment of the Association between Hypovitaminosis D and Chronic Low Back Pain in South Punjab

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## ABSTRACT

**Objective:** To assess the relationship between hypovitaminosis D and chronic low back pain in South Punjab.

**Materials and Methods:** Retrospective research was done from January 2021 to June 2022. 173 chronic nonspecific low back pain patients presenting in outpatient clinics were included in our study. Two groups were made of all patients, one was vitamin-D level deficient, and the other was a vitamin-D normal group. The blood level of 30 ng/ml of vitamin D was taken as normal. Chronic Low back pain status was analyzed by VAS score. All the demographic data of patients were recorded. The relationship between vitamin D and VAS score was assessed by the spearman coefficient and p <0.05 was taken as significant.

**Results:** The majority of patients had a mean age of 36.45 ± 21 years, were female preponderance, married, and vegetarians with a mean sun exposure time of about 2 hours. In group 1, the vitamin D level was 13.41 ± 3.8 and in group 2 vitamin D was 38.71 ± 5.8 with p value< 0.0001. Spearman rho coefficient was used to assess the relationship between vitamin D and pain score. The result was a negative correlation between these 2 variables (r=-0.572) and p <0.0001.

**Conclusion** This research work showed the significant probability of association between vitamin D level and patients having nonspecific chronic low back pain. There was a negative association between vitamin D level and VAS score of patients having chronic low back pain.

**Keywords:** NSLBP (non-specific low back pain), VAS (visual analog score),25-OH vitamin D.

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## INTRODUCTION

The prevalence of back pain varies considerably and the lifetime prevalence of low back pain is 49 to 85%. 60% of adults report low back pain during their life and 12% have reported it in previous years. 80% of individuals who report to a health care professional for low back pain resume

their activities within 4 to 6 weeks. However, the recurrence rate varies between 25 to 75%.[1,14] Low back pain is classified into two groups: one is specific and the other is nonspecific back pain. Specific low back pain has a pathomorphological cause while nonspecific back pain has no pathomorphological cause. Specific causes are trauma, tumor, infection, and deformity. In nonspecific back pain, there are complaints of pain in the low back region and no nerve compression or serious pathology. Low back pain is classified into acute (< 4 weeks), subacute (4 – 12 weeks), and chronic (> 3 – 6 months).[10] The following models have been made for the classification of nonspecific back pain. One is the peripheral generator model, the second is the neurophysiological pain model, third is the mechanical loading model. The diagnosis of NSLBP is done because the history, physical examination, and investigation do not establish any underlying cause. The natural history indicates that the outcome is favorable but 10% of patients develop chronic back pain. The goal of treatment of the patient with nonspecific back pain is to triage the treatment. This triage system will help in the establishment of rehabilitation programs.[6,7,9]

Vitamin D is a lipid-soluble vitamin. It is a group of sterols that are synthesized endogenously which are hormone precursors. This vitamin has an important role in the absorption and distribution of calcium and phosphorus in bone mineral composition.[3,7,11] Vitamin D deficiency has a relation to chronic low back pain. The normal serum level of vitamin D in the blood is 20 to 30 ng/ml. A level > 30 ng/ml is considered adequate. If the level is < 20 ng/ml, it is considered deficient and if it is <10 ng/ml, this shows severe deficiency. The deficiency of vitamin D varies in different parts of the world. About 1 billion people suffer from vitamin D deficiency. In European countries, 40 to 90% of patients especially the elderly living in society and elderly homes suffer from a vitamin-D deficiency. The deficiency status differs in various parts of the same country.[7,12,15]

The adequate level of vitamin D in the blood is maintained by proper dietary intake and by the transformation of the skin by sunlight. In human serum, there are 2 chemical formulations of vitamin D. One is ergocalciferol which is Vitamin D2 and the other is cholecalciferol which is Vitamin D3. These 2 forms shift to the liver by vitamin-D binding protein. In the liver, hydroxylation occurs and 25-OH-D is formed. This is immunologically active but is biologically inert. The vitamin-D blood level is measured to determine deficiency.[6] The vitamin-D production occurs in the skin through ultraviolet B rays. This depends on the angle of sunlight by which it reaches the earth. In our country's geographic latitude, the synthesis occurs between April to November of the year and the peak time is 11 AM to 4 PM. So during this time, the whole body should be exposed to sunlight. As a result of this about 200,000 IU of vitamin D is synthesized in serum which is equivalent to the requirement of vitamin D.[11,14,17]

Vitamin D deficiency produces symptoms depending on duration and level of deficiency. In children, this leads to rickets and in adults it causes osteomalacia. In some cases, this leads to secondary hyperparathyroidism and osteoporosis. Clinically patients develop widespread bone pains, muscle pains, muscle weakness, and difficulty in walking. There is a decrease in muscle power in the back and neck muscles. This will lead to herniation of discs in the cervical and lumbar region and neurological deficits.[2,5,8]

Multiple previous studies had been done in various disciplines of medicine to check the relation of vitamin D deficiency. Like this correlation was checked in the field of spine surgery, disc degeneration, disc herniation, rheumatological diseases, and fibromyalgia.

Kumaratne et al, studied vitamin D levels in

patients. They found that higher BMI was associated with vitamin D deficiency.[19] One study conducted by Bahinipati et al, found that a maximum number of patients with low back pain had a vitamin D deficiency, and there was a significant association between chronic back pain and vitamin D deficiency.[18]

One study done by Lodh et al, found that 82.5% of patients having nonspecific low back pain were vitamin D deficient while 19.5% of patients were found to have vitamin D normal.[9] There is a very important association between chronic low back pain and deficiency of vitamin D levels. It is already described that the prevalence of vitamin D status varies in different parts of the same country.

The rationale of the present study is to determine the vitamin-D deficiency level in areas of South Punjab to check its correlation with low back pain. As South Punjab is a backward area the majority of people especially in the inner city live in congested places with less sunlight exposure. This group of people includes household ladies, children, and old people. As chronic low back pain is very predominant in this area, its correlation should be checked with the factors. The objective of this study is to check the serum level of vitamin D and associate it with pain level in patients with chronic low back pain in the area of South Punjab.[4,6,17]

## MATERIALS AND METHODS

### Study Design

This was a retrospective observational study done on patients from January 2021 to June 2022. Patients were presented to the outpatient department and they were retrospectively evaluated for all demographic factors and Vitamin D levels.

### Study Setting

This was done in the department of neurosurgery and orthopedic at Bakhtawar Amin medical college and hospital Multan.

### Sampling Technique

A total of 285 patients visited our OPD department with low back pain. Out of these 173 had chronic nonspecific low back pain having no specific cause of pain. These patients were included in our study. A random sampling technique was used to collect data in this study.

### Sample Size

G Power version 3.1.9.4 software was used to calculate sample size and alpha was taken at 0.05. The power of the test was 80%.

### Inclusion Criteria

Patients of both genders have an age range of 19 to 68 years. The duration of chronic low back pain without radiculopathy is 3 to 6 months.

### Exclusion Criteria

The patients having disc herniation, spondyloarthropathies, osteoporosis, osteoarthritis of joints, metabolic diseases of bones, spondylodiscitis, tumors, pregnant women, patients having postmenopausal vitamin D deficiency, patients taking steroids, bisphosphonates and taking vitamin D preparations in last 3 months. Patients having kidney disease, hepatic disease, alcohol intake history, and scoliosis having a recent history of surgery or hospitalization are not included in the study.

### Data Collection Procedure

Patients from OPD were taken in the study. All demographic data were collected including age, gender of patients, marital status of patients, educational level, sun exposure, dietary status whether vegetarian or non-vegetarian, sun

exposure time, and occupation were recorded. Body height and weight were recorded and BMI was calculated. BMI less than 18.5 was considered underweight, 18.5 – 24.9 was considered as healthy weight, 25 - 29.9 was considered overweight and over 30 was taken as obese.[2,5,17,14]

Serum vitamin D level 25 (OH) level was calculated by enzyme-linked immunosorbent assay (ELISA). These patients were divided into two groups. Group 1st was vitamin D deficient with serum value < 30 ng/ml. Group 2nd had a normal serum level of vitamin D(serum level above 30 ng/ml). Low back pain status was assessed on the visual Analogue Scale (VAS). In VAS when the patient reported 0 on the scale, it was taken as no pain, and 10 was marked as maximum pain[4,6,13].

## Statistical Analysis

Statistical pack of social sciences (SPSS) version 21.0 was used to analyze the data. The categorical variables like the gender of patients, education status, marital status, dietary status, and BMI index status were analyzed by frequencies and percentages. Numeric variables like the age of patients, sun exposure time, vitamin-D levels, and pain score on VAS were analyzed by mean ± SD. To determine the correlation between numeric data, the spearman coefficient was used. To check the normality of data distribution, the Kolmogorov-Smirnov test was used. To determine the degree of significance between quantitative variables, paired sample t-test was used and for qualitative variables, the Chi-Square test was used. P value < 0.05 was taken as significant.[5,9,11]

# RESULTS

A total of 285 patients visited our OPD department with low back pain. Out of these 173 had chronic nonspecific low back pain having no specific cause of pain. Out of these 119 (68.7%) patients were in Group 1st (Vitamin-D deficient group) and 54 (31.2%) patients were in group 2nd (Vitamin-D normal group).

## Age & Gender Distribution

The age distribution of patients was 36.45 ± 21 in group 1 and 42.32 ± 17 in group 2 patients. 111 patients (64.16) patients were females and 62 (35.8%) patients were males. Among female patients, 87 patients (78.37%) were in the first group and 24 (21.6%) patients were in the second group. Out of male patients, 48 patients (77.4%) were in group 1st and 14 (22.5%) patients were in group 2nd.

## Demographic Variables Distribution

As far as the educational level is concerned, 24 patients (13.8%) were illiterate, 45 patients (26.0%) were primary, 41 patients (23.6%) were secondary, 33 patients (19.05%) were intermediate and 30 patients (17.3%) were graduate. Marital status was evaluated 112 patients (64.7%) were married and 61 patients (35.26%) were unmarried. Out of married persons, 74 patients (66.0%) were in the first group and 38 patients (33.92%) were in the second group. Out of single unmarried patients, 42 patients (68.85%) were in the first group and 19 patients (31.14%) were in the second group. Dietary preference was checked and 104 patients (60.11%) were vegetarians and 69 patients (39.88%) were non-vegetarians. Out of vegetarian patients, 68 patients (65.38%) were in the first group and 36 patients (34.61%) were in the second group. Among non-vegetarian patients, 45 patients (65.21%) were in group 1 and 24 patients (34.78%) were in group 2. The mean sun exposure time in group 1 was 1.99 ± 0.2 and in group 2 was 2.3 ± 0.14. BMI was calculated in all patients. 17 patients (9.8%) were in the BMI range < 18.5. 34 patients (19.6%) were in the BMI range of 18.5 – 24.9 with a p-value of 0.19. 98 patients (56.64%) were in the BMI range of 25 – 29.9 and 24 patients (13.87%) were obese having BMI > 30

(Table 1).

## Analytical Analysis

The vitamin-D level was assessed in both groups. In the first group, the mean vitamin D level was 13.41 ± 3.8 and in group 2 mean vitamin D level was 38.71 ± 5.8. The significance was assessed between the two groups and the p-value was 0.0001. This showed that group 1 patients had a significantly higher level of vitamin D as compared to group 2. The VAS score was assessed in both groups, group 1st had a mean VAS score of 6.38 ± 4.1, and group 2 patients had a mean VAS score of 5.44 ± 1.41 with p value 0.0001. This showed a significant difference in pain severity in patients in group 1 and group 2 (Table 2).

## Vitamin-D & VAS Correlation

Spearman rho coefficient test was used to determine the relation between vitamin D levels and VAS score. This showed a negative correlation between these 2 variables (r= -0.572) and p-value < 0.0001. The results revealed a significant negative association between vitamin D level and pain score. This showed that by decreasing the level of vitamin D in the blood, the tendency of chronic nonspecific low back pain increased and there was a significant correlation between these two variables (Table:2).

**Table 1:** Demographic Analysis of variables.

| | First Group | Second Group | Patients | P-value of Group 1st vs. Group 2nd |
|---|---|---|---|---|
| Number of patients | 119 | 54 | 173 | |
| Age(mean ± SD) | 36.45 ± 21 | 42.32 ± 17 | | 0.64 |
| Gender of patients | | | | |
| Female | 87 | 24 | 111 | |
| Male | 48 | 14 | 62 | |
| Educational status | | | | |
| Illiterate | 19 | 5 | 24 | 0.07 |
| Primary | 39 | 6 | 45 | |
| Matriculation | 33 | 8 | 41 | |
| Intermediate | 24 | 9 | 33 | |
| Graduate | 21 | 9 | 30 | |
| Marital status | | | | |
| Married | 74 | 38 | 112 | 0.72 |
| Unmarried | 42 | 19 | 61 | |
| Dietary preference | | | | |
| Vegetarian | 68 | 36 | 104 | 0.57 |
| Non vegetarian | 45 | 24 | 69 | |
| Sun exposure time | 1.99 ± 0.2 | 2.3 ± 0.14 | | 0.67 |
| Body Mass Index | | | | |
| < 18.5 | 11 | 6 | 17 | |
| 18.5 – 24.9 | 25 | 9 | 34 | 0.19 |
| 25 – 29.9 | 72 | 26 | 98 | |
| > 30 | 19 | 5 | 24 | |

**Table 2:** Analytical Analysis of Vitamin-D & VAS.

| | Group 1 | Group 2 | P value |
|---|---|---|---|
| Vitamin D level | 13.41 ± 3.8 | 38.71 ± 5.8 | 0.0001 |
| VAS Score | 6.38 ± 4.1 | 5.44 ± 1.41 | 0.0001 |

## DISCUSSION

Low back pain is the pain originating between the rib costal margin superiorly and gluteal folds inferiorly. Its duration varies for different people. If it is more than 6 months, it will be called chronic back pain.[2] Chronic low back pain itself is not a disease but a symptom that indicates an underlying disease. It has become a big cause of morbidity in both developed and underdeveloped areas of the world. Low back affects the performance of individuals at their workplace and as a result, this causes a huge economic burden on the country and families. The estimated world-level prevalence of low back pain is 53 – 78%.[3,7] In Pakistan, about 60% of patients suffer from back pain during their life. Back pain restricts mobility, and interferes with activities of daily living. If back pain persists for more than 6 months then it will be called chronic low back pain. There are two diagnostic classifications of back pain. One is specific back pain with or without radiculopathy. In these cases, there is some underlying cause of low back pain.[2,6,10] Other is nonspecific low back pain having no evidence of underlying cause like disc protrusion, spondyloarthropathies, lumbar spinal stenosis, and tumors. 75 to 85% of patients presenting with OPD with back pain have a nonspecific cause behind it. Several factors play a crucial role in the pathogenesis of back pain including old age, smoking history, stress factors related to family and occupation, and lifestyle.[6,11,18] As far as the management of chronic low back pain is concerned, initially, medical management with acetaminophen, nonsteroidal anti-inflammatory medications, and muscle relaxants is beneficial. Other treatment modalities are exercise therapy regimens. A variety of exercise programs including flexion-extension exercises, dynamic exercises, and jogging are beneficial. Manual therapy including TENS, therapeutic heat, and magnetic therapy are also beneficial. Psychological treatment including cognitive behavioral therapy is also beneficial.[3,7,12]

The vitamin-D has a very important part in chronic back pain management. First, we know that 60 – 9 % of Pakistani people are deficient in vitamin D. Vitamin D is very important in calcium metabolism.[4,18] It helps in calcium absorption, transport, and bone mineralization. The target organs are the small gut and bones. Naturally, there are two sources of vitamin D. One is directly from the dietary intake and the other is indirectly from the skin by the action of ultraviolet rays in sunlight. For those people who do not get adequate sunlight, it is recommended to take 400 – 700 IU of vitamin D daily. Those who do not get sufficient intake of vitamin D via diet and also are not exposed to sunlight develop vitamin D deficiency. Vitamin D is inactive in its initial form and the transformation of vitamin D to its active form takes place in the liver and 25-OH is formed.[7] Then further hydroxylation occurs and 1,25 dihydroxy cholecalciferol which is activated is synthesized. This terminal metabolite acts on the small intestine, leading to the absorption of calcium from here. In bone, it promotes osteoclast activity and indirectly assists bone mineralization by enhancing the transport of calcium across the cell membrane.[3,5,9]

Vitamin D deficiency causes an imbalance of calcium and phosphorous metabolism. With hypovitaminosis D, the absorption of calcium will not occur from the small intestine. This will decrease the calcium and phosphorous level in the blood. The bone skeleton will become the primary source of calcium and phosphorous in blood so leading to bone demineralization and osteomalacia.[9,12,18] This will lead to osteopenia and osteoporosis. Vitamin D has anti-inflammatory properties by increasing the cytokine having anti-inflammatory properties. With a deficiency of vitamin D, there is inflammation of bone having more bone turnover like vertebral endplates leading to vertebral endplate fractures. Vitamin D deficiency had been studied in multiple clinical conditions like chronic pain syndromes, pregnant women with chronic

low back pain, failed spine surgery, fibromyalgia, and chronic fatigue syndromes.[8,10,16]

In this study, we studied the vitamin-D status in people of South Punjab and correlated it with nonspecific chronic low back pain. In our study age of patients who presented with OPD was 36.45 ± 21 years. In another study done by Gai et al, their mean age was 43.8 years.[16] In another study done by Lodh et al and in their study, the age group was 32 – 51 years and the mean age was 43.2 ± 3.2 years.[9] So vitamin D deficiency occurs predominantly in the middle ages. In our research, we found the female preponderance of vitamin D deficiency. There are multiple factors for the cause. Another study done by Mabey et al, showed the female preponderance with vitamin D deficiency.[6] One reason is the dietary restriction and poor access to a diet rich in vitamin D. Other reasons are that in areas of South Punjab, the majority of females are housebound. They do not have adequate sunlight exposure leading to vitamin D deficiency. Another reason is biological changes in the body during pregnancy, breastfeeding, and the physical stress of child-rearing. The educational status of people had an important role in society. Those people who are literate know which foods are rich in vitamin D and they take adequate sunlight exposure.[20] This is helpful in vitamin D deficiency treatment. Vegetarians were considered to be vitamin-D deficient in comparison to non-vegetarians. In our research, we found that vegetarians are more deficient in Vitamin D as compared to non-vegetarians. Sunlight exposure time varies among different people. Darker skin people require prolonged exposure to sunlight as compared to light skin colored people to maintain the blood level of vitamin D. South Punjab being a tropical country had adequate sunlight exposure. Sunlight exposure time is directly correlated with vitamin D levels.[21] In our study, the results correlated with international data. BMI status was checked in our patients having normal and deficient vitamin-D levels. Kumaratne et al, studied vitamin D levels in patients. They found that higher BMI was associated with vitamin D deficiency.[19] Our data correlated with this study with patients having vitamin-D deficiency who had a higher level of BMI. The reason behind this is that adipose tissue in obesity collects 25 OH cholecalciferol levels resulting in a negative relationship between vitamin D and BMI. Obesity is a significant risk factor that is continuously increasing in our population. Vitamin D is a lipid-soluble vitamin so it inversely correlates with total lipid stores in the body.[4,9]

As far as the association between vitamin D levels and low back pain was concerned, various studies had been done with variable results. One study done by Lodh et al, found that 82.5% of patients having nonspecific low back pain were vitamin D deficient while 19.5% of patients were found to have vitamin D normal.[9] One study conducted by Bahinipati et al, found that the maximum number of patients with low back pain had a vitamin D deficiency, and there was a significant association between chronic back pain and vitamin D deficiency.[18] Another research done by lofty et al found a significant association between vitamin-D serum level and the status of chronic low back pain. Our study results correlated with these studies. One study done by Ghai et al, found no relationship between vitamin D levels and chronic back pain.[15] VAS score in vitamin-D deficient group 1 was 6.38 ± 4.1 and in vitamin D normal group 2 was 5.44 ± 1.41 with p values <0.001. Spearman rho coefficient was used to determine the association between vitamin-D levels and VAS score. This showed a negative correlation between these 2 variables (r=-0.572) and p-value < 0.0001.

## CONCLUSION & RECOMMENDATION

Chronic back pain is a common presentation in our outpatient clinics. The majority of patients had no specific pathology. Our research found that a significant number of patients were

deficient in vitamin D levels and the VAS score was higher in patients with vitamin D deficiency. Vitamin D screening is very important in the population so that the majority of patients with chronic back pain presenting to primary care physicians can be benefited.

## LIMITATIONS

The first limitation of the study is that it was a retrospective study. We collected data from patients presented to our hospital outpatient department. Prospective studies are required for the association between vitamin D deficiency and chronic low back pain. The second limitation is that there should be further randomized trials with large sample sizes and focused age groups which will further improve the correlation. The values of serum calcium, magnesium, and alkaline phosphatase level were not assessed in our study which was associated with vitamin D metabolism.

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## Additional Information

**Disclosures:** Authors report no conflict of interest.

**Conflicts of Interest:**

In compliance with the ICMJE uniform disclosure form, all authors declare the following:

**Financial Relationships:** All authors have declared that they have no financial relationships at present or within the previous three years with any organizations that might have an interest in the submitted work.

**Other Relationships:** All authors have declared that there are no other relationships or activities that could appear to have influenced the submitted work.

## AUTHORS CONTRIBUTIONS

| Author's Full Name and Affiliation | Intellectual/Contribution to Paper in Terms of: |
|---|---|
| 1. Waqas Noor Chughtai | 1. Study design and methodology. |
| 2. Manqoosh Ur Rehman | 2. Paper writing, referencing, data calculations and |
| 3. Muhammad Adeel Razzaque | 3. Data collection and calculations. |
| 4. Azhar Rashid | 4. Analysis of data and interpretation of results etc. |
| 5. Tanveer Ahmad | 5. Literature review and manuscript writing. |
| 6. Muhammad Tahir | 6. Analysis of data and quality insurer. |