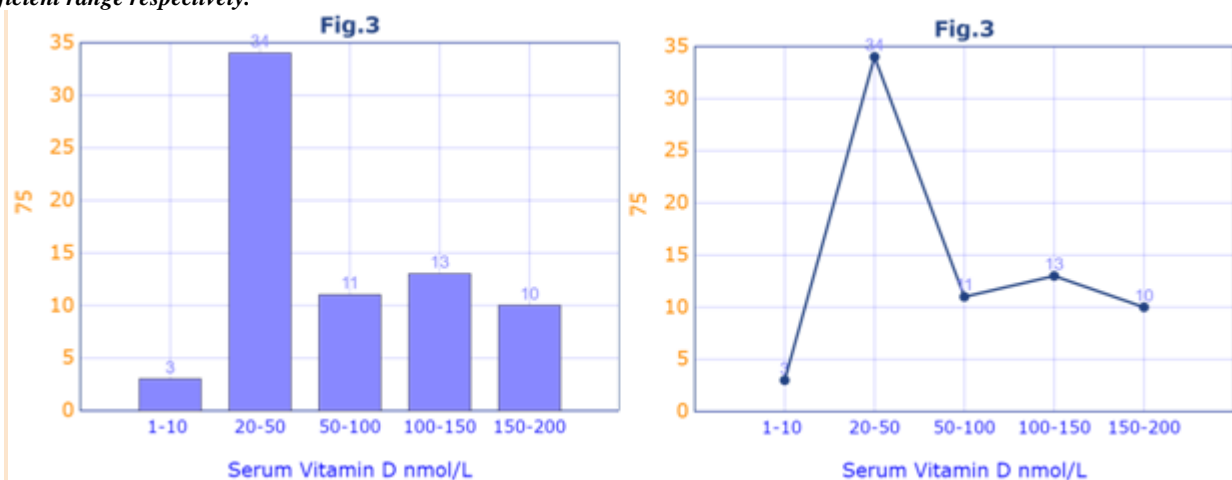


# The Trend of Vitamin D3 Deficiency in Younger Populations with Spinal Cord Injury in Pakistan

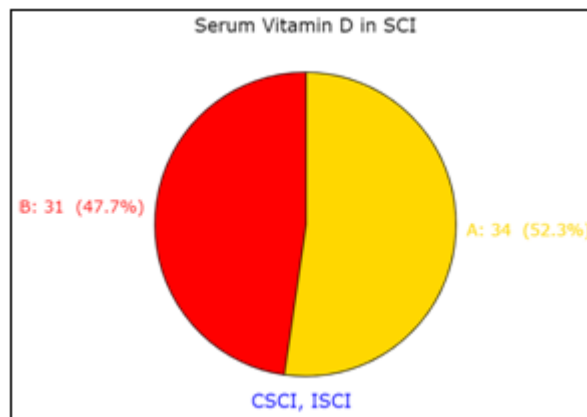
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**Abstract:** *Background:* Vitamin D3 deficiency has been reported as a worldwide epidemic and has been detected in 53.3% of the population in Pakistan. [1] It has been found as well that low levels of vitamin D3 are implicated as a primarily etiological factor for many bone diseases. As a result, many growing publications stated the prevalence of vitamin D deficiency in acute and chronic spinal cord injury patients. [2 - 4] The early detection of vitamin D3 deficiency, especially in younger patients, followed by an early treatment plan is essential for the prevention of osteoporosis and its long - term related consequences, hence making it essential to study the trend of Vitamin D3 levels in younger populations with Spinal Cord Injury. [5] *Objective:* Our study aims to detect the status of serum 25 - hydroxy vitamin D [vitamin D25 (OH) ] levels in younger patients with acute and chronic spinal cord injury (SCI) to make an early diagnosis of sublesional bone loss and to advocate the supplementation of Vitamin D3 as a treatment for sublesional osteoporosis thus lowering the morbidity and mortality among young patients with SCI. *Methods and Materials:* It was a prospective cohort study. The study was conducted in SCI trauma center at the Mayo Hospital Lahore, Pakistan over a 1 - year duration. The sample size comprised of eighty - five patients. The sampling method used was stratified random sampling. The patients included in the study aged between 12 and 35 years with documented new onset of SCI based on history, clinical neurological examination and radiological findings, and they were classified as having complete or incomplete sensorimotor impairments according to level of SCI. The patients excluded from the study were patients with other comorbidities that could interfere with the serum vitamin D3 levels and those younger than 12 years or older than 35 year. SPSS version 27 was used for data analysis. Samples were collected according to hospital policy after obtaining written consent from the patients in the regional language. The assessment was done using the American Spinal Cord Injury Association Scale (ASIA) spine scoring scheme. Vitamin D3 was measured using the standard measurement technique at the local hospital diagnostic center. The studied subjects were divided into 2 groups: Group A included complete SCI patients as ASIA grade 5, and Group B included incomplete SCI patients as ASIA grade 1 - 3. On further work up, among these two groups, and depending upon serum concentrations of 25 (OH) D levels, patients were classified into vitamin D deficient with a serum level less than <30 nmol/L, vitamin D insufficient with a serum level between 30 to <50 nmol/L, and vitamin D sufficient with a serum level greater than ≥50 nmol/L (According to NIH). *Results:* Mean vitamin D3 level in 75 ASCI subjects (mean age 30.82 ± 6.77 years, was 20.56 ± 11.22 ng/ml. Fifty subjects (58.82%) were vitamin D deficient, 15 subjects (17.64%) were vitamin D insufficient and the rest (n=20, 23.52%) were vitamin D sufficient. There was no significant difference in vitamin D levels as per gender, age, mode of trauma, type of injury and injury location. Patients admitted on the fifth day of injury had maximum vitamin D levels (mean 25.7143 ± 8.32 ng/ml). The mean vitamin D level of subjects with samples taken during the summer season was significantly higher as compared to the winter season (p value <0.05). Study included a total of seventy - five patients with 35 female and 40 male patients aged between 12 and 35 with documented SCI. A blood sample for 25 (OH) D concentration was drawn upon admission for both groups and one after 6 months at follow up. Mean ± SD serum 25 (OH) D concentration in group A (complete spinal cord injury at presentation) was 31.81 ± 13.79 nmol/L (range from 20 to 50 nmol/L) and 20.43±13.51 nmol/L (range from 8 to 45 nmol/L) at 6 months after injury, in low and insufficient range respectively.



In incomplete spinal cord injury designated as group B, mean ± SD serum 25 (OH) D concentration was 84.47 ± 49.38 nmol/L (range from 45 to 160 nmol/L) at presentation and 150.24 ± 49.17 nmol/L (range from 50 to 200 nmol/L) at 6 months after injury, in adequate and high range respectively with a p - value of 0.001 (According to NIH). 52.3% of participants were with CSCI at presentation and 47.7% of participants were with incomplete spinal cord injury (ISCI).



**Keywords:** Spinal cord injury; serum 25 (OH) D, ASIA score.

## 1. Introduction

Over the years, Vitamin D has become the focus of extensive scientific research, especially in SCI patients, mainly due to its wide range of biological actions that go beyond its endocrine effects on calcium and phosphorus homeostasis. With the associated expression of vitamin D - metabolizing 1 -  $\alpha$  hydroxylase, as well as the vitamin D receptor (VDR) in multiple other extra - renal tissues, Vitamin D has raised the possibility of its wide array of both autocrine and paracrine actions that target different body systems, especially the skin, immune system, and the musculoskeletal system [6]. To ensure both the endocrine and paracrine activity of Vitamin D, it's essential to maintain a sufficient level of serum 25 - hydroxyvitamin D (25 - OH - D), as the function of the extra - renal 1 -  $\alpha$  hydroxylase activity appears to be strongly linked to the level of its substrate. However, Vitamin D deficiency and insufficiency have been announced to be a global pandemic that affects more than one billion children and adults around the world [7]. Low vitamin D levels in patients can result from reduced sunlight exposure, seasonal variations, and racial and ethnic disparities. This deficiency affects both pathways of Vitamin D and may explain the possible link between Vitamin D deficiency and multiple comorbidities which includes chronic musculoskeletal pain, cardiovascular disease, inflammatory disorders, nephropathy, as well as mood disorders [8]. Interestingly, spinal cord injury (SCI) has been linked to similar post - injury health issues [9], so, and considering that vitamin D serum levels may be related to the prognosis of clinical outcomes in these patients, early screening, detection, attainment, and maintenance of these levels is therefore suggested as a desired clinical goal.

In fact, both acute and chronic SCI patients have been shown to have reduced vitamin D levels [8] [9]. Possible contributing factors include seasonal variations, poorly developed countries, tight resources, insufficient degree of sun exposure, limited oral intake, obesity, lack of screening for detection of levels of vitamin D, use of substances (e. g., some medications) or conditions (e. g., kidney/liver disease) affecting vitamin D metabolism. The Endocrine and Neurosurgical Societies Clinical Practice Guidelines on Vitamin D have not produced explicit population - specific or clinically relevant recommendations, despite the fact that SCI patients have a higher chance of having impaired

vitamin D status. Only a few restricted protocols based on novel studies have been formulated on individual - based scenarios to be tested in adults with SCI and varying degrees of improvement. However, no sufficient studies addressing vitamin D supplementation strategies shortly after an initial SCI, despite the remarkable prevalence of vitamin D deficiency found in adults sustaining a new SCI and even more so in chronic conditions [10] [11]. Thus, it's essential to establish evidence - based, safe, and effective vitamin D regimens to be initiated upon admission into inpatient rehabilitation so as to minimize the risk of above mentioned secondary complications and to maximize the benefits of rehabilitation interventions. Our study aims to detect the status of serum 25 - hydroxy vitamin D [vitamin D25 (OH)] levels in acute and chronic spinal cord injury (SCI) patients to make an early diagnosis of bone loss and to advocate the supplementation of Vitamin D3 as a treatment for sublesional osteoporosis thus lowering the morbidity and mortality among patients with SCI.

## 2. Discussion

Vitamin D3 insufficiency is a common problem in spinal cord injury (SCI) patients. This is due to a variety of factors, including limited mobility and decreased exposure to sunlight, which is the primary source of vitamin D for humans. Research has shown that vitamin D deficiency in SCI patients is associated with a range of negative health outcomes, including decreased bone density, increased risk of fractures, and impaired immune function. Additionally, there is evidence to suggest that vitamin D may play a role in the prevention and management of neuropathic pain, a common complication of SCI. Therefore, it is important for SCI patients to receive regular monitoring of their vitamin D levels and to take steps to maintain adequate levels through supplementation and/or increased exposure to sunlight. Consultation with a healthcare provider is recommended to determine the appropriate dosage and frequency of vitamin D supplementation based on individual needs and medical history. Spinal cord injury (SCI) can result in a number of health complications, including musculoskeletal, cardiovascular, respiratory, and metabolic disorders. One of the complications that can arise in SCI patients is vitamin D insufficiency.

Vitamin D is an essential nutrient that plays a key role in maintaining bone health, regulating immune function, and modulating inflammation. However, individuals with SCI are at an increased risk of developing vitamin D insufficiency due to a number of factors, including reduced exposure to sunlight, decreased mobility, and impaired absorption of vitamin D. Research has shown that vitamin D insufficiency is common in SCI patients, with prevalence rates ranging from 30% to 90%. Vitamin D insufficiency in SCI patients can lead to a number of adverse health outcomes, including decreased bone density, increased risk of fractures, and impaired immune function.

Therefore, it is important for SCI patients to have their vitamin D levels monitored regularly and to receive appropriate supplementation if necessary. The optimal level of vitamin D for SCI patients is not well - established, but a level of 30 ng/mL or higher is generally considered adequate. It is also important for SCI patients to engage in regular physical activity and to get as much exposure to sunlight as possible, as these factors can help improve vitamin D status. Additionally, consuming foods that are rich in vitamin D, such as fatty fish and fortified dairy products, can also help improve vitamin D status in SCI patients. [11]

Vitamin D is an essential nutrient that plays a crucial role in maintaining bone health, muscle function, and immune system function. Spinal cord injury (SCI) patients are at increased risk of developing vitamin D insufficiency due to a variety of factors such as limited mobility, decreased sun exposure, and reduced dietary intake.

Vitamin D insufficiency in SCI patients can have several negative consequences. Firstly, it can lead to decreased bone density, which can increase the risk of fractures and other bone - related complications. Secondly, it can contribute to muscle weakness and atrophy, which can further limit mobility and increase the risk of falls. Thirdly, vitamin D is important for immune system function, and insufficiency can increase the risk of infections. To address vitamin D insufficiency in SCI patients, it is important to ensure that they are getting adequate dietary intake and sun exposure. In cases where this is not possible, vitamin D supplements may be recommended. It is important to consult with a healthcare provider to determine the appropriate dosage and type of vitamin D supplement based on individual needs and health status. Overall, monitoring and addressing vitamin D insufficiency in SCI patients can help to promote bone health, muscle function, and immune system function, which can improve overall quality of life and reduce the risk of complications.

Limitations of study included pre - existing mineral and vitamin D3 deficiencies that were not in the scope of study, seasonal variations of vitamin D3 were not taken into account, and also corticosteroids that were administered to most patients with spinal cord injury were not taken into account. This study poses questions that whether pre - existing vitamin D3 deficiency was responsible for a more severe SCI or later as the consequence of it, however, the need of active vitamin D3 supplementation especially in younger population is paramount, and as is the need of

active physiotherapy and rehabilitation to restrict immobilization that can trigger bone loss and further disruption of vitamin D3 levels that has many important functions in the body and immune system. Bigger studies including more variables at multi centers are requested to define the formation of clinical evidence based guidelines in the treatment of SCI patients especially in younger population and to guide the population about the need of having frequent vitamin D3 level checks and supplement intake of foods rich in vitamin D3 and omega3 fatty acids with some form of workout combination to augment bone, spine health and durability despite spinal cord traumas to decrease the morbidity associated with it to help reserve the resources that burdenise the crippling health system in developing countries. Vitamin D3 insufficiency is a common problem in spinal cord injury (SCI) patients. This is due to a variety of factors, including limited mobility and decreased exposure to sunlight, which is the primary source of vitamin D for humans.

### 3. Conclusion

Vitamin D3 insufficiency was found more severely in complete spinal cord injury at presentation and at 6 months after injury, in low and insufficient range respectively as compared to incomplete spinal cord injury at presentation and 6 months after injury, in adequate and high range respectively, with a p - value of 0.001 signifying that vitamin D3 levels are affected more severely in CSCI in younger population.

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