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## The Prevalence of Low Vitamin D3 Levels in Patients with Lumbar Disc Herniation and Its Relationship with Different Patient Parameters

Rabail Akbar Qazi<sup>1</sup>, Lal Rehman<sup>1</sup>, Farrukh Javeed<sup>1</sup>, Sana Akbar Qazi<sup>1</sup>, Tanweer Ahmed<sup>1</sup>  
Asad Abbas<sup>2</sup>

<sup>1</sup>Department of Neurosurgery, Jinnah Postgraduate Medical Centre (JPMC), Karachi, Pakistan

<sup>2</sup> Nottingham University Hospital, Queen's Medical Centre Campus, UK

### ABSTRACT

**Objective:** To determine the prevalence of low vitamin D3 levels in patients having proven lumbar disc herniation and its relationship with different patient parameters.

**Materials and Methods:** This is a prospective study carried out on 100 patients at the Neurosurgery department, Jinnah postgraduate medical center from Feb 2018 to April 2019. Serum Vitamin D levels and other characteristics were assessed in patients with prolapsed lumbar intervertebral discs. Low levels of Vitamin D were defined as insufficiency (10 ng/ml – 30 ng/ml) and deficiency (< 10 ng/ml).

**Results:** Out of 100 patients in the study, only 21% had optimal serum vitamin D3 levels, and 79% had hypovitaminosis (57% insufficient and 22% deficiency). Low vitamin D levels were prevalent in all age groups, with deficiency more prevalent in the older age group (p-value = 0.004). The BMI (body mass index) of the patients showed a linear correlation with vitamin D levels.

**Conclusion:** Decreased vitamin D levels are prevalent in patients having herniated lumbar discs. The study showed that older-aged patients and high BMI exhibited severe vitamin D deficiency. As a result, recommendations are that preventive initiative for this specific hypovitaminosis target a broader population to intercept the occurrence of low vitamin D levels and the associated repercussions.

**Keywords:** Vitamin D, Prolapsed intervertebral disc, hypovitaminosis.

**Corresponding Author:** Rabail Akbar Qazi  
Department of Neurosurgery, Jinnah Postgraduate  
Medical Centre (JPMC), Karachi, Pakistan  
Email: dr.rabailakbar@hotmail.com

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### INTRODUCTION

Low backache remains one of the leading motives

of visits to a neurosurgery outpatient department, with approximately 80% of the population experiencing it at least once in their lifetime.<sup>1</sup> It is one of the leading causes of disability in patients under the age of 45 years.<sup>2</sup> Although, there is a wide array of conditions that may lead to low back pain, spinal degenerative diseases take up a fair share. Among these diseases, lumbar disc herniation remains a quite common cause of lower back ache (1 – 3%), potentially leading to a radiculopathy.<sup>3-6</sup>

Lumbar disc herniation is most prevalent in middle age, ranging from 35 to 50 years.<sup>7</sup> This condition is more commonly seen in males as compared to females. Other risk factors include obesity,<sup>8</sup> smoking, and motor vehicle driving. Genetic predisposition also plays a part, as shown in several studies.<sup>9,10</sup> Another factor that is considered high risk for lumbar disc herniation is low levels of vitamin D3.

Vitamin D is an endogenously produced secosteroid, with a wide spectrum of functions, covering both skeletal and non-skeletal systems.<sup>11</sup> One of these many important functions is neuromodulation and acting as a protective agent in the detoxification pathways.<sup>12-14</sup> The disc is composed largely of avascular tissue. Therefore, the balance between the nutritional supply and excretion of waste products is very sensitive to the environment surrounding the disc. The property of vitamin D to down-regulate pro-inflammatory cytokines and upregulate anti-inflammatory cytokines is important in the inhibition of disc degeneration.<sup>15,16</sup> It also helps modulate pain and the threshold of pain is lowered with low levels of the said vitamin.

Treatment of prolapsed intervertebral disc can be divided as being non-surgical and surgical. Non-surgical treatment mainly includes lifestyle changes and activity modifications as well as exercise and/or physiotherapy. Medical management includes the use of analgesics, and muscle relaxants along with calcium and vitamin supplements if indicated. After initiating

conservative treatment, up to 90% of patients will experience a relief in their symptoms within one month.<sup>17</sup> Surgery is indicated in those who experience no improvement on medical management, worsening of symptoms or progressive neurological deficit as well as significant nerve root or thecal compression on MRI.

The objective of the study was to identify the burden of vitamin D deficiency in the patient population having a prolapsed lumbar intervertebral disc. PID negatively impacts the quality of life and poses a significant socioeconomic burden to society. A lot of these patients remain dependent on pain medications chronically and even then, the pain isn't controlled well. If a significant relationship is established between PID (prolapsed intervertebral disc) and Vitamin D deficiency, it will lead to a drastic change in management strategy and will help in enhancing the quality of life and reducing the disease's chronicity.

## MATERIALS AND METHODS

### Study Design and Setting

It is a prospective, cross-sectional study conducted in the Neurosurgery department of Jinnah Postgraduate Medical Centre Karachi, Pakistan. The study includes 100 patients randomly taken from the outpatient department as well as patients who were admitted for surgical intervention from April 2018 to June 2019.

### Inclusion Criteria

The inclusion criteria consisted of all people with proven prolapsed lumbar intervertebral discs on MRI.

### Exclusion Criteria

Patients with recurrent prolapsed discs were excluded from the study.

## Data Collection

The patients were divided into three age-based groups; Ages: 18 – 30 yrs (Group A), 31 – 45 yrs (Group B), and 46 years and above (Group C). Data was collected using a proforma which included demographics, BMI, lower backache with any associated radiation to lower limbs, the severity of the backache, and radiological features of the prolapsed lumbar intervertebral disc on magnetic resonance imaging.

The severity of the pain was scored using the Visual Analog Score. BMI score was calculated by measuring the height and weight of the patients using a standard scale and dividing them into different groups: Underweight, normal, overweight, and obese. The 25-Hydroxyvitamin D levels were measured in the serum of the study population. These levels were then divided into three groups; Deficient (< 10 ng/mL), Insufficient (11 – 30 ng/mL), and Optimal (31 – 100 ng/mL).

## RESULTS

### Levels of vitamin D3

Only 21% had optimal serum vitamin D3 levels, and 79% had vitamin D3 deficiency (57% insufficient and 22% severe deficiency) (Table 1).

**Table 1:** Prevalence of low vitamin D levels.

Vitamin D Levels	Percentage
Sufficient	21 (21%)
Insufficient	57 (57%)
Severe Deficiency	22 (22%)

## Gender

There were 72% females and 28% males among the 100 patients enrolled in our study. Females had generally lower levels of vitamin D3 (81.9%) as compared to males (71.4%) but the difference was not statistically significant. Insufficient Vitamin D levels were present in 59.7% of the females, while deficiency was seen in 22.2%. In comparison, 50% of males had insufficiency and 21.4% had a deficiency of vitamin D3.

## Age

Based on age, the mean age at presentation was 41.1 years. Out of these, 22% of patients were in group 1, 49% in group 2, and 29% in group 3. Based on age, low vitamin D levels were prevalent in all age groups, with insufficiency being more prevalent in the younger and middle age and deficiency more prevalent in the older age group, the p-value being significant (p value= 0.004) (Table 2).

### The Severity of Pain

On pain assessment using visual analog pain score, the distribution was 21% patients having mild pain, 40% moderate, 20% severe, and 17% in the categories of very severe to worst possible pain. However, our data did not show any linear correlation of the visual pain score with the deficiency of vitamin D levels. A deficiency was observed in 95.2% of patients having mild pain, 67.5% of patients with moderate pain, 80% of patients with severe, and 82.3% of patients with severe to worst possible pain.

**Table 2:** Vitamin D level distribution according to age.

Vitamin D levels	Age Groups			Total	p-value
	Group A	Group B	Group C		
Sufficient	8	6	7	21	0.004*
Insufficient	13	34	10	57	(*significant result)
Severely Deficient	1	9	12	22	

## BMI

Comparing the BMI, 5% of our study population was underweight, 28% had a normal BMI, 39% were overweight and obesity was seen in 28%. Comparing the BMI with the vitamin D levels, 60% of the underweight patients showed deficiency, 75% of normal weighted individuals, 79.4% of overweight, and 85.7% of obese patients had low vitamin levels (Table 3).

**Table 3:** Vitamin D deficiency according to BMI.

BMI	Vitamin D Deficiency
Underweight	3 (60%)
Normal	21 (75%)
Overweight	31 (79.4%)
Obese	24 (85.7%)

## DISCUSSION

Vitamin D insufficiency is now considered a worldwide health issue. Degeneration of the intervertebral disc is a multifactorial process, with genetic predisposition as well as environmental factors playing a pivotal role. These factors trigger a cascade of molecular events which eventually lead to the wearing and prolapse of the disc. Serum vitamin D levels are one of the factors with low levels thought to be leading to acceleration of the degenerative process.

There is very limited data available in our country regarding the levels of vitamin D in the general population. Zolfaghari et al. reported deficiency (< 9 ng/dl) in 83% of 110 patients.<sup>18</sup> Stoker et al, in their study, showed that vitamin D deficiency (< 20 ng/ml) was found to be 27% and insufficiency (< 30 ng/ml) was seen in 57% of the patients.<sup>19</sup> Another study reported the rate of hypovitaminosis to be 74.3%.<sup>20</sup>

In the literature, females are found to be more at risk for developing hypovitaminosis.<sup>21</sup> Zadro et al. reported that low levels of vitamin D were more often seen in younger women.<sup>22</sup> This female preponderance was also seen in a study carried

out in Iran, which is a country geographically similar to our region.<sup>23</sup> Another study showed that hypovitaminosis was prevalent in both genders.<sup>24</sup> Out of 72 females enrolled in our study, 59.7% exhibited vitamin D insufficiency and 22.2% had a deficiency. In comparison, out of 28 males, insufficiency was seen in 50% and 21.4% were deficient. Overall, the gender predilection was statistically insignificant.

The association between low vitamin D levels and age in patients having a prolapsed intervertebral disc is subject to variation. All the age groups showed low levels of vitamin D3. In patients more than 46 years of age, this relationship was statistically significant (p-value = 0.004). When compared to the literature, a study conducted by Lodh et al, showed that low vitamin D was frequently observed in those aged above 60 years and having chronic low backache.<sup>25</sup> However, Zolfaghari et al. reported in their study that younger age groups had lower levels of vitamin D3.<sup>18</sup> In contrast to that, another study showed no significant association between age and vitamin D3 levels.<sup>26</sup>

In our study, we observed that there was no direct linear relationship between the pain with the levels of vitamin D3. Hicks et al. reported that older women having low levels of vitamin D3 had more severe backache.<sup>27</sup> Another study similarly reported that more severe pain was seen in patients having low levels of the vitamin.<sup>28</sup> In contrast, Johansen et al. reported no relationship between the severity of the pain and hypovitaminosis.<sup>26</sup>

Literature review showed that being overweight and obese notably increased the risk of having lumbar disc prolapse.<sup>29</sup> Since our study is inclusive of patients already having a prolapsed disc, the incidence of low vitamin D was compared with the BMI of the patients. Literature showed that there was a steady decline in the serum vitamin D3 levels with an increasing range of BMI of patients.<sup>30</sup> Similarly, another study showed that obesity was associated with lower

vitamin D3 levels.<sup>31</sup> Our study showed similar results where increasing BMI showed lower levels of serum vitamin D3.

## CONCLUSION

The study highlights the increased incidence of low vitamin D3 in patients who have herniated lumbar discs. Although the severity of the symptoms did not directly correlate with the levels of the vitamin, studies with a larger sample size should be carried out to accurately demonstrate the relationship. With increasing age, the levels of vitamin D3 seem to be decreasing. The same goes for increasing BMI. Strategies should be developed to address this issue at the community as well as national level and awareness campaigns should be designed so that vitamin D deficiency should be tackled.

## RECOMMENDATIONS:

Large-scale population-based studies to determine the relationship between low vitamin D levels with herniated lumbar discs should be carried out to determine whether the deficiency is simply an associated factor rather than an impact factor in the pathophysiology of the prolapsed lumbar intervertebral disc or if it has a more significant role. Strategies should be developed to address this issue at the community as well as national level and awareness campaigns should be designed so that vitamin D deficiency should be tackled.

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## Additional Information

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

**Ethical Review Board Approval:** The study was conformed to the ethical review board requirements.

**Human Subjects:** Consent was obtained by all patients/participants in this study.

### 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.

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## AUTHOR CONTRIBUTIONS

Sr. No.	Author's Full Name	Intellectual Contribution to Paper in Terms of
1.	Rabail Akbar Qazi	Study Design, methodology, and paper writing.
2.	Asad Abbas, Rabail Akbar Qazi	Data calculation and data analysis.
3.	Farrukh Javeed	Interpretation of results.
4.	Sana Akbar Qazi	Statistical analysis.
5.	Tanweer Ahmed	Literature review.
6.	Lal Rehman	Literature review and quality insurer.