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Exploring the Association between Vitamin D3 Levels and Back Pain: A Cross-Sectional Study

Sadaf Nasir [a++], Manzar Hussain [b++], Muhammad Yassar Jazaib Ali [b#*], Amna Ghouri [b†] and Sant Piyari [b†]

[a] Department of Radiology, Liaquat National Hospital and Medical College, Pakistan.
[b] Department of Neurosurgery, Liaquat National Hospital and Medical College, Pakistan.

Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Background: Lower vitamin D3 levels have been implicated in various musculoskeletal disorders, including back pain. This study was aimed to investigate the relationship between vitamin D3 levels and incidence of back pain and its severity in adults.
Methods: We conducted a cross-sectional study involving 100 adult participants. Demographic information, serum vitamin D3 levels, back pain assessments using validated questionnaire, and details about medication use, medical history, and comorbidities were collected. Ethical considerations were kept in view as per hospital guidelines.

[++] Associate Professor;
[#] Senior Registrar;
[†] Resident;
**Corresponding author: E-mail: yasirkhebar@yahoo.com;*

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Results: The study involves 100 patients, with 61.7% males and 31.8% females, aged 17 to 70 years (average 38.88, SD 13.458). 33% reported routine activity. Most patients (49.5%) experienced symptoms for over 8 months. Vitamin D3 levels correlated negatively with disability levels ($r = -0.334$, $p < 0.001$) and symptom duration ($r = -0.315$, $p = 0.001$). Higher disability levels correlated with longer symptom duration ($r = 0.407$, $p < 0.001$). Regression analysis shows Oswestry Disability Index significantly predicts Vitamin D3 levels ($p < 0.001$, standardized coefficient -0.336), while routine activity does not ($p = 0.932$). Our findings revealed a negative correlation between vitamin D3 levels and back pain severity.
Conclusions: These results support the hypothesis that lower vitamin D3 levels are associated with increased back pain severity in adults. Further investigation is required to confirm these findings and elucidate the underlying mechanisms linking vitamin D3 deficiency to back pain. Potentially, our findings can inform public health initiatives and guide the development of targeted interventions to reduce the burden of back pain caused by vitamin D3 insufficiency.

Keywords: Vitamin D3; back pain; epidemiology; cross-sectional study; public health initiatives; adults.

1. INTRODUCTION

Low back pain (LBP) is a common musculoskeletal disorder that affects a large proportion of the adult population worldwide. Lower back pain (LBP) stands as a formidable health challenge globally, not only due to its prevalence but also because it ranks as the primary cause of disability-adjusted life years in both developed and developing nations [1]. The economic repercussions of LBP are profound, transcending borders and impacting productivity and healthcare expenditure all over the globe. Beyond its impact on individual well-being, LBP imposes a substantial economic burden on healthcare systems worldwide [2,3]. Vitamin D3 deficiency has been implicated in various musculoskeletal disorders, including LBP. Several studies have investigated the relationship between vitamin D3 levels and LBP, but the results have been inconsistent [4].

The relationship between low back pain and low levels of vitamin D3 has gained significant attention in the medical literature, recently. Studies suggest a link between vitamin D3 deficiency and the prevalence of low back pain. Mechanistic insights have shown that vitamin D receptors in musculoskeletal tissues may influence pain perception and inflammatory processes [5,6]. Inadequate vitamin D3 levels are associated with impaired muscle function, decreased bone mineral density, and altered neuromuscular control, contributing to low back pain development or persistence [7,8].

Healthcare providers should consider assessing vitamin D status in patients with chronic or recurrent low back pain symptoms. Routine screening for vitamin D3 deficiency and appropriate supplementation strategies could improve outcomes [9,10]. Future research should focus on optimal dosing regimens and interventions to address vitamin D insufficiency in managing low back pain. Understanding the epidemiological correlations and mechanistic pathways linking low vitamin D3 levels to low back pain can enhance patient care by addressing musculoskeletal health and vitamin D status simultaneously. The study results could provide valuable insights into the relationship between vitamin D3 levels and back pain, informing public health initiatives and effective interventions to reduce the burden of back pain associated with vitamin D3 insufficiency [8,11].

This study aims to investigate the association between lower vitamin D3 levels and back pain in adults. The results of this study could have significant implications for public health initiatives and the development of targeted interventions to reduce the burden of back pain caused by vitamin D3 insufficiency.

2. METHODOLOGY

The research utilized a cross-sectional study design involving 100 individuals aged 17 to 70 years to explore the relationship between vitamin D levels and back pain. Inclusion criteria comprised individuals within the specified age range presenting with symptoms of back pain. Exclusion criteria included individuals with known mechanical causes of back pain such as osteoporosis, osteopenia, spondylolisthesis، any known malignancy, presence of lumbar spinal stenosis.

Data collection encompassed a comprehensive approach. Firstly, demographic information

including age and gender was gathered to provide context to the sample population. Secondly, participants' routine physical activity habits were assessed, with routine activity defined as engaging in physical activity or exercise at least three days a week for a minimum of 45 minutes. This data aimed to examine the potential influence of physical activity on vitamin D levels and back pain. Thirdly, the duration of back pain symptoms was recorded to understand the temporal aspect of the condition. Lastly, vitamin D levels were measured through blood samples to provide quantitative data for analysis. The utilization of blood sample reports ensured accurate and objective measurement of vitamin D levels, a crucial aspect of the study's methodology.

Following data collection, descriptive statistics were employed to summarize the collected data, including measures such as means, standard deviations, and percentages. These statistical summaries provided a concise overview of the sample characteristics and key variables. Subsequently, correlation analysis was conducted to explore the relationships between vitamin D levels, disability levels (assessed using the Oswestry Disability Index), and symptom duration. This analysis aimed to identify potential associations between these variables and uncover patterns within the data.

To further investigate the associations of vitamin D levels and low back pain, a regression model was constructed. This model included variables such as routine activity and disability index, allowing for a comprehensive examination of the factors leading to back pain in individuals with back low vitamin d levels. The significance of the regression model was assessed using a significance test, providing valuable insights into the overall predictive power of the model. Additionally, standardized coefficients were examined to understand the strength and direction of the relationships between the predictors and the outcome variable.

Ethical considerations were paramount throughout the research process. Measures were taken to ensure participant confidentiality and compliance with institutional guidelines. As the study involved only the cross-sectional collection of data without any interventions, it was conducted under a waiver of consent granted by the relevant institutional review board. This approach ensured the ethical conduct of the study while respecting participants' rights and privacy.

3. RESULTS

The sample consists of 100 individuals with ages ranging from 17 to 70 years. The average age is approximately 38.88 years, with a standard deviation of approximately 13.458. This means that most ages fell within roughly 13.458 years of the average age. Out of 100 patients, 66 (61.7%) were male, and 34 (31.8%) were female. The routine activity is defined as physical activity/exercise at least 3 days a week for at least 45 minutes. Out of the total patients, 33% reported engaging in routine activity. Conversely, 67% reported not engaging in routine activity. Most patients (49.5%) indicated experiencing symptoms for over 8 months, followed by 21.5% reporting symptoms lasting between 3 to 8 months, and 22.4% experiencing symptoms for less than 3 months. The data shows a mean Vitamin D3 level of around 16.7699 with a standard deviation of approximately 9.36478.

Lower levels of Vitamin D3 are significantly associated with higher disability levels according to the Oswestry Disability Index at the time of clinical presentation ($r = -0.334$, $p < 0.001$), as well as with a longer duration of symptoms ($r = -0.315$, $p = 0.001$). Additionally, higher disability levels at presentation are significantly associated with a longer duration of symptoms ($r = 0.407$, $p < 0.001$). (Table 1). These findings highlight the importance of considering Vitamin D3 levels in relation to disability levels and symptom duration in the context of the Oswestry Disability Index at the time of clinical presentation.

The regression model is statistically significant ($p = 0.003$), indicating that the predictors collectively have a significant effect on Vitamin D3 levels. Among the predictors, only the Oswestry Disability Index at the time of clinical presentation has a statistically significant effect on Vitamin D3 levels ($p < 0.001$), with a negative standardized coefficient of -0.336. This indicates that higher levels of disability at presentation are associated with lower Vitamin D levels. The predictor "routine activity" is not statistically significant ($p = 0.932$), suggesting that it does not have a significant effect on Vitamin D3 levels in this model. (Table 2). Therefore, the model suggests that the Oswestry Disability Index at the time of clinical presentation is a significant predictor of Vitamin D3 levels, while routine activity does not significantly contribute to predicting Vitamin D levels in this context.

Table 1. Pearson correlation analysis to examine the relationships between vitamin D levels, disability levels (assessed using the Oswestry Disability Index), duration of symptoms and age

		Vitamin D levels	Oswestry Disability Index at the time of clinical presentation	Duration of symptoms	Age
Vitamin D levels	Pearson Correlation	1	-.334**	-315**	-.194
	Sig. (2-tailed)		<.001	.001	.054
	N	100	100	100	100
Oswestry Disability Index at the time of clinical presentation	Pearson Correlation	-.334**	1	.407**	-.156
	Sig. (2-tailed)	<.001		<.001	.121
	N	100	100	100	100
Duration of symptoms	Pearson Correlation	-315**	.407**	1	.147
	Sig. (2-tailed)	.001	<.001		.144
	N	100	100	100	100
Age	Pearson Correlation	-.194	-.156	.147	1
	Sig. (2-tailed)	.054	.121	.144	
	N	100	100	100	100

***Correlation is significant at the 0.01 level (2-tailed)*

Table 2. Coefficients table for linear regression model to identify predictors of vitamin D levels, including routine activity and disability index. The model's significance was assessed using a significance test, and standardized coefficients were examined to determine the strength and direction of the relationships

	Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig
		B	Std. Error	Beta		
1	(Constant)	32.427	5.985		5.418	<.001
	Oswestry Disability Index at the time of clinical presentation	-6.499	1.879	-.336	-3.458	<.001
	Routine Activity	-.164	1.930	-.008	-.085	.932
a. Dependent Variable: Vitamin D levels						

4. DISCUSSION

The association between low back pain and low levels of vitamin D3 has gained significant attention in the medical literature. Emerging evidence suggests a potential link between vitamin D3 deficiency and the prevalence of low back pain. Several epidemiological studies have reported an association between low serum vitamin D3 levels and an increased risk of experiencing low back pain [12,13].

Furthermore, studies have identified potential role of vitamin D3 hypovitaminosis on pain pathway [5]. Evidence suggests that vitamin D3 deficiency can precipitate muscle weakness and pain in both adults and children, highlighting the broad-reaching implications of inadequate vitamin D3 levels on musculoskeletal health [14,15]. Moreover, the immunomodulatory actions of vitamin D3 further underscore its potential as a therapeutic target for managing LBP [16]. Importantly, studies have demonstrated improvements in bone density and musculoskeletal symptoms with vitamin D supplementation, suggesting a potential avenue for alleviating LBP symptoms [17]. The observed reduction in inflammatory cytokine synthesis and concurrent increase in anti-inflammatory cytokines following vitamin D supplementation further support its role in modulating the inflammatory milieu implicated in LBP pathogenesis [18,19]. The clinical implications of this association are significant and healthcare providers must consider assessing vitamin D3 status in patients presenting with chronic or recurrent low back pain symptoms. Routine screening for vitamin D3 deficiency and appropriate supplementation strategies may help improve outcomes in individuals with low back pain [20]. Moreover, the recognition of vitamin D3 deficiency as a potentially treatable problem offers hope for individuals grappling with undiagnosed musculoskeletal pain. By addressing vitamin D3 insufficiency through supplementation, clinicians may offer patients a viable adjunct therapy to alleviate LBP symptoms and improve overall musculoskeletal health. Future research should focus on elucidating optimal dosing regimens and therapeutic interventions to address vitamin D3 insufficiency in the management of low back pain [21]. By understanding the epidemiological correlations and mechanistic pathways linking low vitamin D3 levels to low back pain, healthcare professionals can enhance patient care by addressing both musculoskeletal health and vitamin D3 status in individuals with this condition [22].

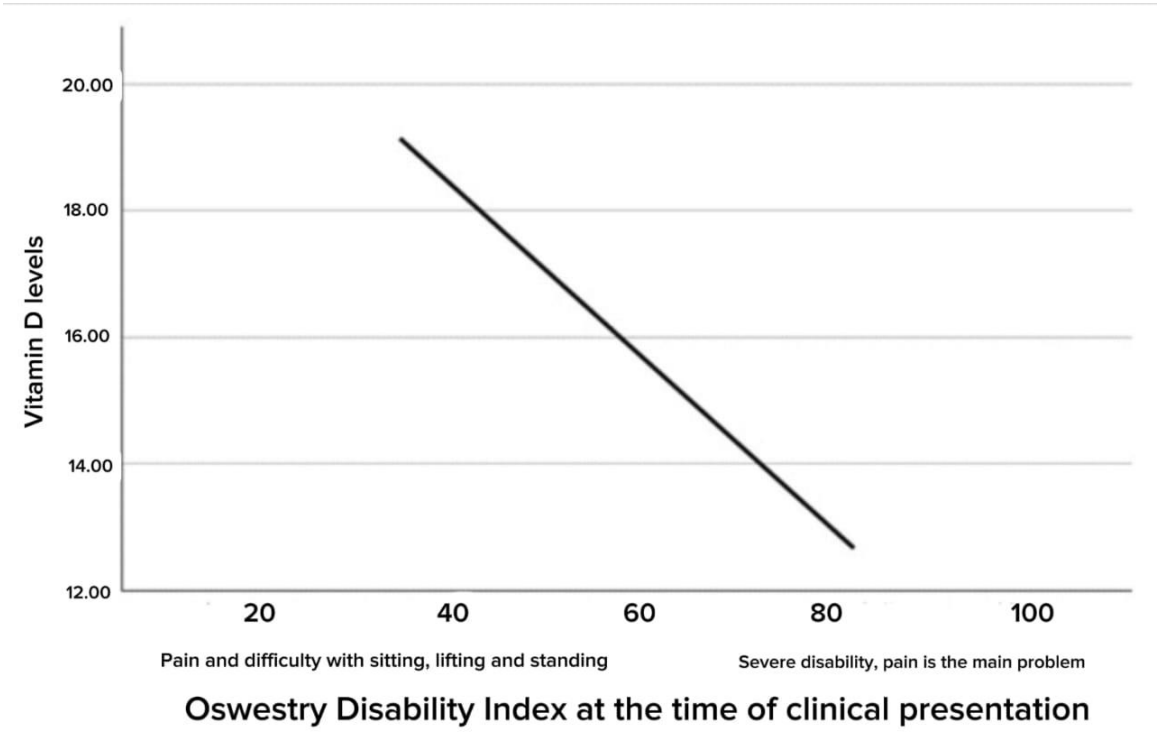

Fig. 1. Figure depicting the negative correlation between vitamin D levels and back pain severity assessed by Oswestry Disability Index

The present study aimed to investigate the association between lower vitamin D3 levels and back pain severity in adults. The study's findings indicate a significant negative correlation between Vitamin D3 levels and disability severity, as assessed by the Oswestry Disability Index (ODI), upon initial clinical presentation. This implies that individuals with lower Vitamin D3 levels tend to exhibit higher levels of disability at the time of assessment. Moreover, a similar negative correlation was observed between Vitamin D3 levels and symptom duration, suggesting that lower levels of Vitamin D3 are associated with prolonged symptom duration. Furthermore, the analysis unveiled a positive correlation between disability severity at presentation and symptom duration, underscoring the interconnectedness of disability severity and symptom persistence. Regression analysis revealed that the collective predictors significantly influence Vitamin D3 levels, with the ODI score at initial clinical presentation emerging as the sole predictor with a statistically significant effect. This implies that higher disability levels at presentation are associated with lower Vitamin D3 levels. Conversely, routine activity did not demonstrate a significant effect on Vitamin D3 levels within this model. The negative correlation between vitamin D3 levels and back pain severity observed in our study is consistent with previous research. (Fig. 1) Vitamin D3 plays a crucial role in maintaining bone health and muscle function, [23] and its deficiency has been linked to various musculoskeletal disorders, including back pain. Vitamin D3 insufficiency may lead to decreased muscle strength, impaired neuromuscular function, and increased inflammation, all of which could contribute to the development and progression of back pain [24].

5. CONCLUSION

In conclusion, our study provides valuable insights into the relationship between vitamin D3 levels and back pain severity in adults. Our findings suggest that lower vitamin D3 levels are associated with increased back pain severity, even after controlling for potential confounding factors. Further investigation is required to confirm these findings and elucidate the underlying mechanisms linking vitamin D3 deficiency to back pain. Potentially, our findings can inform public health initiatives and guide the development of targeted interventions to reduce the burden of back pain caused by vitamin D3 insufficiency.

6. STRENGTHS AND LIMITATIONS

Our study has several strengths, including a well-structured epidemiological study design, a reasonable sample size, and the use of validated questionnaires to assess back pain severity. However, there are also some limitations to consider. First, the cross-sectional study design limits our ability to establish causality between vitamin D3 levels and back pain severity. Second, the study population was limited to adults with back pain, which may limit the generalizability of our findings to other populations. Third, we did not measure other potential confounding factors such as dietary intake of vitamin D3 or sun exposure, which could have influenced our results.

This study underscores the potential significance of Vitamin D3 status in relation to disability severity and symptom duration among individuals presenting with musculoskeletal issues. These findings suggest that monitoring and potentially supplementing Vitamin D3 levels may be pertinent for managing such conditions, particularly in individuals exhibiting higher disability levels upon initial clinical evaluation. Our findings highlighted a significant association between lower vitamin D3 levels and higher disability levels, as well as with longer symptom duration. Routine activity, however, did not emerge as a significant predictor of vitamin D3 levels in this context. These results underscore the importance of considering vitamin D3 levels in relation to disability and symptom duration, suggesting potential implications for clinical practice and future research.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of this manuscript.

CONSENT

As per international standards or university standards, patient(s) written consent has been collected and preserved by the author(s).

ETHICAL APPROVAL

As per international standards or university standards written ethical approval has been collected and preserved by the author(s).

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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