Research Article

Does Vitamin D Deficiency Cause Chronic Low Back Pain: A Case-Control Study

Muhammad Tahir Ghani,[1] Syed Hassan Murtaza Shah,[2] Akkad Rafiq,[3] Nain Sukh[4]

[1]Department of Surgery, Aero Hospital, Wah Cantt, Pakistan; [2]Department of Medicine, Aero Hospital, Wah Cantt, Pakistan; [3]Department of Orthopaedics, Benazir Bhutto Medical College, Mirpur Azad Kashmir; [4]Hi-Tech Medical College, Taxila

Abstract

Background: Chronic low back pain (CLBP) is an important cause of morbidity worldwide and is routinely treated by vitamin D supplementation alongwith other measures. Whether vitamin D deficiency is responsible for CLBP, is a matter of debate. The aim of this case-control study is to find out weather vitamin d deficiency is associated with CLBP.

Objective: The objective of the study to find out whether hypovitaminosis D causes CLBP.

Methods: This case-control study was conducted in the Department of Surgery and Medicine of Aero Hospital Wahcantt from 2ndMay 2022 to 31May 2023 after ethical approval from IMC vide letter No 44(33)/2023-IMC. 195 cases of CLBP and an equal number of controls were selected through non-probability convenience sampling. After matching confounding factors between the two groups, their vitamin D levels were recorded. The null hypothesis that there is no difference between the mean vitamin D level of cases and controls was tested by applying an independent sample t-test. Taking vitamin D levels below 20ng/ml as hypovitaminosis D, the odds ratio was calculated as well.

Results: Both groups, cases, and controls had an equal number of males (n=63, 32.3%) and females (n=132, 67.7%). The mean age of cases was 44.6 years with SD ± 13.54 while the mean age of controls was 45.2 years with SD ± 13.46 years. The mean level of vitamin D of patients was 23.22 ng/ml with SD ± 17.76 while the mean vitamin D level of controls was 26.48ng/ml with SD ± 20.64. Independent sample t-test showed that there is no statistical significant difference between the mean vitamin D levels of the two groups (p-value > 0.05). The odds ratio was 1.31 showing no or very weak correlation between hypovitaminosis D and CLBP.

Conclusion: There is no causal relationship between CLBP and hypovitaminosis D.

Corresponding Author | Dr. Muhammad Tahir Ghani, Consultant Surgeon, Head of Surgery Department, Aero Hospital, Wah Cantt, Pakistan ; **Email:** doctortahir226@gmail.com

Keywords | Chronic low back pain (CLBP), Hypovitaminosis D, Odds ratio.

Introduction

Chronic low back pain (CLBP) is defined as low back pain that lasts for more than 03 months or that recurs frequentlyduring06 months or beyond.[1-3]

Production and Hosting by KEMU

https://doi.org/10.21649/akemu.v23i4.5429

CLBP causes significant morbidity, abstinence from work, and poor quality of life both in men and women across the globe[4]. Multiple visits to outpatient departments and indoor admissions due to CLBP burdens the health care system and the socioeconomic cost is high.[4] The prevalence of CLBP is high both in developed and underdeveloped countries.[5,6] There are many causes of CLBP like spinal disc disease, spinal stenosis, osteoarthritis, infection, trauma, osteoporosis, sacroiliac joint

dysfunction, failed back surgery, and malignancy,[7,8] but in a majority of patients clinicians label the pain as nonspecific or mechanical as no obvious pathology can be found.[9,10]

Optimum levels of vitamin D are essential for musculoskeletal health.[11,12] The prevalence of Vitamin D deficiency is high in Pakistan and other South Asian countries.[13] A serum level of vitamin D less than 20ng/ml is considered a deficiency of vitamin D, while a level between 20-30ng/ml is considered insufficient.[12,13] According to many studies hypovitaminosis D is associated with CLBP,[12,14] however, this association is not established and evidence is lacking. Many studies do not support a causal relationship between hypovitaminosis D and CLBP.[15]

The objective of this case-control study is to find out the association between hypovitaminosis D and CLBP. This study will determine whether a causal relationship exists between vitamin D deficiency and CLBP. If hypovitaminosis D is found to be the cause of CLBP, correction of vitamin D levels in CLBP patients will benefit and improve this chronic, debilitating disease.

Methods

This case-control study was conducted in the Department of Surgery and Medicine of Aero Hospital Wahcantt from 2nd May 2022 to 31May 2023 after ethical approval from IMC vide letter no44(33)/2023-IMC. Aero Hospital has a total patient load of approximately 100,000. Taking chronic low back pain (CLBP) prevalence as high as 50% based on the reference study conducted by Shetty GM6 in India, the population size of CLBP patients was assumed as 50,000. With 5% margin of error, 95% confidence interval and population size of 50,000,the sample size was calculated using Raosoft calculator[16] and it turned out to be 382. We included 195 cases of CLBP and 195 controls not having CLBP.

Our null hypothesis was that there is no association between chronic low back pain and hypovitaminosis D. If the null hypothesis is true, there will be no significant difference between means of vitamin D levels of cases and controls, and the odds ratio will be equal to or less than 01. Our alternate or research hypothesis was that there is an association between chronic low back pain and hypovitaminosis D. In this case there will be a significant difference between means of vitamin D levels of cases and controls and the odds ratio will be more than 01. Cases and controls were selected through non probability convenience sampling technique. All patients above 12 years of age presenting with CLBP in the medicine and surgery department were advised on vitamin D levels. Patients with spinal disc disease, fractures, and infections of the spine like tuberculosis and spinal tumors were excluded. Controls were selected from the same hospital. These were either healthy attendants of patients who opted for vitamin D levels voluntarily or patients with problems other than CLBP. Cases and controls were matched in terms of confounding factors like age, gender, and sun exposure. Both cases and controls were advised vitamin D levels on a venous sample in a non-fasting state from the same laboratory and the results recorded after arrival of reports.

For data entry and statistical analysis, windows compatible SPSS version 25 was used. Descriptive statistics were represented as mean, median, mode, and standard deviation. An Independent sample t-test was applied to compare the means of vitamin D levels of cases and controls. T-test was also applied to see whether there was a statistically significant difference between vitamin D levels of males and females. Taking vitamin D less than 20ng/ml as hypovitaminosis D, the odds ratio was calculated using a classic 2×2 table for case-control studies. P value less than 0.05 was set as statistically significant.

Results

Both groups, cases, and controls had an equal number of males (n=63, 32.3%) and females(n=132, 67.7% as shown in the pie charts (figure 1). Both groups were also comparable with reference to age. The mean age of cases was 44.6 years with SD ± 13.54 while the mean age of controls was 45.2 years with SD ± 13.46 years. The minimum age of cases was 14 years while that of control was 13 years. The maximum age of cases was 91 years while of controls was 85 years.

The mean level of vitamin D of patients was 23.22 ng/ml with SD ± 17.76 while the mean vitamin D of controls was 26.48ng/ml ± 20.64 as shown in Table 1.An Independent sample t-test was applied to compare the means of vitamin D levels of cases and controls. Although the vitamin D levels of cases were lower than controls the difference was statistically insignificant. The p-value turned out to be 0.095 (non-significant).Hence null hypothesis cannot be rejected as shown in Table 2.

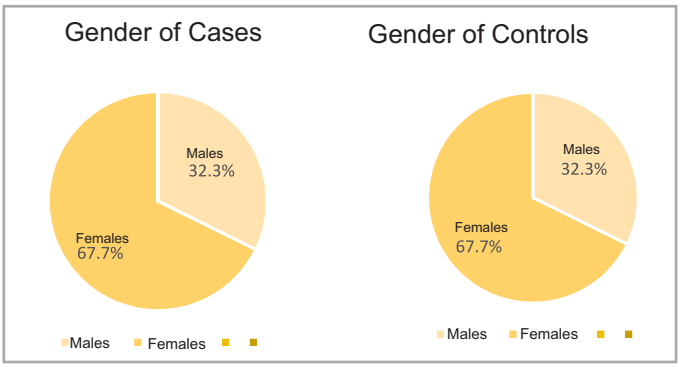

Figure 1. *Gender Distribution of Cases and Controls*

Our sample had overall 32.3% (n=126) males and 67.7% (n=264) females. The mean vitamin D levels of males were 23.57ng/ml SD ± 18.41 while of females was 25.47 ng/ml SD ± 19.72 as shown in Table 3. The mean vitamin D level of males and females was compared by applying independent sample t-test. Although the mean vitamin D level of females was higher than males (25.47>23.57), the difference was not significant p-value = 0.354.

Taking values less than 20ng/ml as hypovitaminosis D, the odds ratio was calculated by using a classic 2×2 table of case-control studies as shown in Table 4.

Table 1: *Mean vitamin D levels of cases and controls*

Group Statistics					
	pt. or control	N	Mean	Std. Deviation	Std. Error Mean
Vit D	pt.	195	23.2272	17.76798	1.27239
	control	195	26.4899	20.64691	1.47856

$$\text{Odds ratio} = \frac{ad\ (118\times90)}{bc\ (105\times77)}$$

$$\text{Odds ratio} = 1.31$$

The odds ratio was noted as 1.31 showing no or very weak correlation between hypovitaminosis d and CLBP.

Table 3: *Comparison of vitamin D levels of males and females*

Group Statistics					
	Gender	N	Mean	Std. Deviation	Std. Error Mean
Vit d levels	Males	126	23.5772	18.41233	1.64030
	Females	264	25.4701	19.72268	1.21385

Table 4: *Odds ratio calculation*

Hypovitaminosis d Vit d ≤ 20	Cases N=195	Controls N=195
Present	a(118)	b(105)
Absent	c(77)	d(90)

Discussion

Chronic low back pain (CLBP) is the most common complaint by which patients present to the surgical outpatient department of any hospital5,6.Vitamin D deficiency is thought to be related to CLBP.[11,12] We seldom see any prescription for a patient of CLBP without heavy doses of vitamin D and calcium supplements whether rationale exists or not. This case-control study was intended to determine any causal relationship between CLBP and hypovitaminosis D.

Vitamin D is necessary for musculoskeletal health and its optimum levels are important for normal bone and muscle functioning.[11,12] Vitamin D has an essential and important role in phosphate and calcium metabolism and is important for mineralization of bone.[17,18] The prevalence of vitamin D deficiency is high in Pakistan and other subcontinent countries which has similar socio-economic conditions. According to a study conducted by Siddiqee MH[13] prevalence of vitamin D deficiency was found as high as 73% in Pakistan and the mean vitamin D levels were found as low as 17ng/ml. In our study, we collectively found the mean vitamin D level of both

Table 2: *Independent sample t-test to compare vitamin D means of cases and controls*

Independent Samples Test										
		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
Vit d	Equal variances assumed	2.996	.084	-1.673	388	.095	-3.2627	1.95067	-7.0979	.57249
	Equal variances not assumed			-1.673	379.56	.095	-3.2627	1.95067	-7.0981	.57276

cases and controls as 24.85ng/ml. The systematic review and meta-analysis conducted by Siddiqee MH et al[13] concluded that seven out of ten individuals have vitamin D deficiency in South Asia and countries like Bangladesh, Nepal, SriLanka, and India all have mean vitamin D levels below 20ng/ml. Vitamin D levels less than 20ng/ml are defined as a deficiency of vitamin d.[17,18] In our study, we found 60% (n=118) cases and 53% (n=105) controls having vitamin D levels less than 20 ng/ml thus having vitamin D deficiency. The overall incidence of hypovitaminosis D in our study i.e. less than 20 ng /ml was 57%.

Does hypovitaminosis D cause CLBP is a matter of debate. Literature shows conflicting results and there is significant heterogeneity in results. In our study, we noted that although cases of CLBP has lower mean vitamin D levels as compared to controls (23.33ng/ml vs. 26.66ng/ml), the difference was not statistically significant ($p > 0.05$). Hence the null hypothesis that there is no significant difference between vitamin D levels of cases and controls can not be rejected. Al Tair A[19] in his cross-sectional study of 760 adult school boys in Kuwait also had similar results and found no significant difference between vitamin D levels of CLBP patients and normal population without back pain. Thronboy[15] in his case-control study of 44 cases and controls in Sweden also found no correlation between vitamin D levels and CLBP. He found equal mean vitamin D levels in cases and controls with no significant difference. Kumar M[20] in his study of 1152 patients of CLBP in Karachi Pakistan also found no association between CLBP and vitamin D deficiency. Taking vitamin D levels less than 20 ng/ml we calculated the odds ratio by applying the classic 2×2 table of case-control studies as shown in table 04.In our study odds ratio was 1.31 which suggests a very weak or no relationship between hypovitaminosis D and CLBP.

Many studies suggest a significant association between hypovitaminosis Dand CLBP.Kanaujia V12 in his study of 376 patients of CLBP in India found a high incidence of hypovitaminosis D in patients of CLBP. Studies suggest that replacing vitamin D or supplementation can significantly improve pain in patients with CLBP. Cai C[21] in his study demonstrated a 70 % improvement in pain in 4 patients of CLBP and neck pain with correction of vitamin D. Brady SRE[22] in his RCT also demonstrated improvement in pain and reduced disability in patients treated with vitamin D than placebo. Bansal D[23] in his Meta-analysis included 14 studies and concluded a high prevalence of hypovitaminosis D in patients of CLBP although he found marked heterogeneity as well.

CLBP is more prevalent in females. In our study, we found 67.7% (n=132) female patients with CLBP compared to males 32.3% (n=63). Female gender was associated more with CLBP in studies conducted by Palacios-Cena D[24], Wu A et al[25], and Kahere M et al[26]. In our study, we did not find any gender association with vitamin D deficiency. We found a slightly increased mean level of vitamin D(25.4ng/ml vs 23.5ng/ml) in females as compared to males although the difference was statistically insignificant (p-value 0.36). Ricart B[27] also found no gender association with vitamin D deficiency. The study conducted by AlQuaiz AM[28] in saudia found that the deficiency of vitamin D was more prevalent in adult males as compared to females.

The strength of our study is its case control design which significantly determines the causal relationship between cause and effect. Also, the matching of both cases and controls concerning confounding factors was done well. The limitation noted in our study was that the majority of cases and controls belong to the same socioeconomic status. So further studies are needed across various socioeconomic classes to achieve uniformity of results.

Conclusion

Although the deficiency of vitamin D is highly prevalent in our society, there is no causal relationship between hypovitaminosis D and CLBP. The null hypothesis that there is no significant difference between the mean vitamin D level of cases and controls cannot be rejected. Also, the odds ratio was 1.31 which does not support a causal relationship between hypovitaminosis D and CLBP.

Ethical Approval: The ethical committee of Islamabad Medical Complex- Nescom approved the study vide letter No. NESCOM-44(33)/2023-IMC

Conflict of Interest: The authors declare no conflict of interest.

Funding Source: None

Authors' Contribution

MTG: Conception and design, data drafting and final approval of the version

SHMS: Data acquisition, revising article and final approval of the version

AR: Interpretation of data, revising article and final approval

NS: Data analysis, revising article and final approval

References

1. Akhtar RR, Ahmed R, Ashraf S, AshrafO, Shafique U, Mureed A.Effect of Vitamin-D supplementation in adults presenting with chronic lower back pain Rawal Med. J. 2020;24(2):161-5.
2. Fatima K, Bhatti ZM, Khan I, Akbar U. Effect of Chronic Low Back Pain on Balance and functional mobility in Women. J Riphah Coll. Rehab.Sci. 2021; 9(2): 71-4.
3. Khan M, Zafar H, Gilani SA. Inter-rater reliability of pressure biofeedback unit among individuals with and without chronic low back pain. Pak J Med Sci. 2022; 38(4): 987-91.
4. Mauck MC, Aylward AF, Barton CE, Birckhead B, Carey T, Dalton DM, et al. Evidence-based interventions to treat chronic low back pain: treatment selection for a personalized medicine approach. Pain Rep. 2022; 7(5): e1019. doi: 10.1097/PR9.0000000000001019.
5. Alhowimel AS, Alodaibi F, Alshehri MM, Alqahtani BA, Alotaibi M, Alenazi AM. Prevalence and Risk Factors Associated with Low Back Pain in the Saudi Adult Community: A Cross-Sectional Study. Int. J. Environ. Res. Public Health. 2021;18(24):13288. doi: 10.3390/ ijerph182413288.
6. Shetty GM, Jain S, Thakur H, Khanna K. Prevalence of low back pain in India: A systematic review and meta-analysis. Work 2022;73(2):429-52. doi: 10.3233/ WOR-205300.
7. Urits I, Burshtein A, Sharma M, Testa L, Gold PA, Orhurhu V et al. Low Back Pain, a Comprehensive Review: Pathophysiology, Diagnosis, and Treatment. Curr Pain Headache Rep. 2019;23(3):23. doi: 10. 1007/ s11916-019-0757-1.
8. Riley SP, Swanson BT, Cleland JA. The why, where, and how clinical reasoning model for the evaluation and treatment of patients with low back pain. Braz. J. Phys. Ther. 2021;25(4):407-14. doi: 10.1016/ j.bjpt. 2020. 12.001.
9. Adnan M, Ali B, Sajjad MM, Rahman A, Qureshi OR, Darain H. Effectiveness of transcutaneous electric nerve stimulation and interferential current in patients with non-specific Chronic low back pain. J Med Sci. 2020; 28(4): 341-4.
10. Basharat A, Qamar MM, Nasir S, Faraz K. Prevalence of Chronic non-specificmusculoskeletal pain in household females and its impact on quality of life. Pak J Rehab. 2022; 11(1): 47-54.
11. Mendes MM, Botelho PB, Ribeiro H. Vitamin D, and musculoskeletal health: outstanding aspects to be considered in the light of current evidence. Endocr Connect. 2022;11(10):e210596. doi: 10.1530/EC-21-0596.
12. Kanaujia V, Yadav RK, Verma S, Jain S, Patra B, Neyaz O. Correlation between Vitamin D deficiency and non-specific chronic low back pain: A retrospective observational study. J. Family Med. Prim. Care. 2021; 10(2): 893-97. doi: 10.4103/jfmpc.jfmpc_1478_20.
13. Siddiqee MH, Bhattacharjee B, Siddiqi UR, Meshbahur Rahman M. High prevalence of vitamin D deficiency among the South Asian adults: a systematic review and meta-analysis. BMC Public Health. 2021; 21(1): 1823. doi: 10.1186/s12889-021-11888-1.
14. Erdogan B, Kolutek Ay B. Investigation of Vitamin D Levels and the Effects of Being an Agricultural Worker on Etiology and Night Pain in Children and Adolescents with Chronic Low Back Pain. Cureus. 2023; 15(3): e36601. doi: 10.7759/cureus.36601
15. Thorneby A, Nordeman LM, Johanson EH. No association between level of vitamin D and chronic low back pain in Swedish primary care: a cross-sectional case-control study. Scand. J. Prim. Health Care. 2016; 34(2): 196-204. doi: 10.1080/02813432.2016.1183557.
16. Sudarshan A, Mahajan K, Panjaliya RK, Dhar MK, Kumar P. Algorithm for sample availability prediction in a hospital-based epidemiological study spreadsheet-based sample availability calculator. Sci Rep. 2022; 12(1): 1860. doi: 10.1038/s41598-021-03399-1.
17. Charoenngam N, Shirvani A, Holick MF. Vitamin D for skeletal and non-skeletal health: What we should know. J. Clin. Orthop. Trauma. 2019;10(6):1082-93. doi: 10.1016/j.jcot.2019.07.004.
18. Amrein K, Scherkl M, Hoffmann M, Neuwersch SS, Kostenberger M, Tmava BA et al. Vitamin D deficiency: an update on the current status worldwide. Eur. J. Clin. Nutr. 2020;74(11):1498-13. doi: 10.1038/s41430-020-0558-y.
19. Al-Taiar A, Rahman A, Al-Sabah R, Shaban L, AlBaloul AH, Banaee S et al. Vitamin D levels in relation to low back pain during adolescence. Br. J. Nutr. 2020; 123(11): 1302-11. doi: 10.1017/S0007114520000720.

20. Kumar M, Ahmed M, Hussain G, Bux M, Ahmed N, Kumar S. Assessment of Vitamin D Levels in Patients Presenting With Chronic Low Back Pain at a Tertiary Care Hospital. Cureus. 2020;12(12):e11867. doi: 10.7759/ cureus.11867.

21. Cai C. Treating Vitamin D Deficiency and Insufficiency in Chronic Neck and Back Pain and Muscle Spasm: A Case Series. Perm. J. 2019;23(4):18-241. doi: 10.7812/ TPP/ 18.241.

22. Brady SRE, Naderpoor N, de Courten MPJ, Scragg R, Cicuttini F, Mousa A, et al. Vitamin D supplementation may improve back pain disability in vitamin D deficient and overweight or obese adults. J Steroid Biochem Mol Biol. 2019;185(6):212-17. doi: 10.1016/ j.jsbmb. 2018.09. 005.

23. Bansal D, Boya CS, Vatte R, Ghai B. High Prevalence of Hypovitaminosis D in Patients with Low Back Pain: Evidence from Meta-Analysis. Pain Physician. 2018; 21(4):E389-99.https://pubmed.ncbi.nlm.nih.gov/30045605/.

24. Palacios CD, Albaladejo VR, Hernandez BV, LimaFL, Fernandez DLPC, Jimenez-Garcia R et al. Female Gender Is Associated with a Higher Prevalence of Chronic Neck Pain, Chronic Low Back Pain, and Migraine: Results of the Spanish National Health Survey. Pain Med. 2021;22(2):382-95. doi: 10.1093/pm/pnaa368.

25. Wu A, March L, Zheng X, Huang J, Wang X, Zhao J, et al. Global low back pain prevalence and years lived with disability from 1990 to 2017: estimates from the Global Burden of Disease Study 2017. Ann Transl Med. 2020;8(6):299. doi: 10.21037/atm.2020.02.175.

26. Kahere M, Ginindza T. The prevalence and risk factors of chronic low back pain among adults in KwaZulu-Natal, South Africa: an observational cross-sectional hospital-based study. BMC Musculoskelet Disord. 2021; 22(1):955. doi: 10.1186/s12891-021-04790-9.

27. Ricart B, Monteagudo P, Blasco-Lafarga C. Hypovitaminosis D in Young Basketball Players: Association with Jumping and Hopping Performance Considering Gender. Int. J.Environ. Res. Public Health. 2021; 18(10): 5446. doi: 10.3390/ijerph18105446.

28. AlQuaiz AM, Kazi A, Fouda M, Alyousefi N. Age and gender differences in the prevalence and correlates of vitamin D deficiency. Arch Osteoporos. 2018; 13(1): 49-3. doi: 10.1007/s11657-018-0461-5.