

Association Between Serum Vitamin D Level and Common Vestibular Disorders-A Cross-Sectional Study in a Tertiary Care Hospital

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ABSTRACT

Background: Vestibular disorders are a common cause of disabling vertigo and low serum vitamin D can lead to labyrinthine demineralization, otoconial fragility and modulation of pro-inflammatory mediators. It can be hypothesized that there exists an association between low serum vitamin D levels and vestibular disorders. To determine the association between serum Vitamin D levels and common vestibular disorders.

Methods: We conducted a cross-sectional study on 100 subjects of both sexes above 18 years of age in a tertiary care hospital over 3 months to measure vitamin D levels in patients with vestibular disorders. Patients presenting to the outpatient underwent clinical, audiological and vestibular examination and were diagnosed with BPPV, Meniere's disease, or vestibular neuritis. Serum Vitamin D levels were measured for all and compared.

Results: Of the 100 patients studied, 54 were females and 46 were males, while the age range was 25-66 years. The mean serum vitamin D level for patients of BPPV, Meniere's, and vestibular neuritis was 14.5±5.9 ng/ml, 16.9±6.7 ng/ml, and 21.6±7.5 ng/ml, respectively. The results showed that serum vitamin D levels were significantly low in patients with BPPV (p=0.006) and deficiency was also observed in Meniere's disease.

Conclusion: This study concluded that patients of BPPV and Meniere's disease also suffer from Vitamin D deficiency. Measurement of vitamin D levels in patients with vestibular disorders like BPPV can be beneficial for further management and treatment.

Key-words: Vestibular disorders, Vitamin D deficiency, BPPV, Meniere disease, Vestibular neuritis

INTRODUCTION

Vitamin D has garnered a lot of attention lately, with its proven function in numerous acute and chronic disorders. Insufficient levels of Vitamin D or its metabolic by-products can disrupt the concentration of calcium, which is essential for maintaining normal vestibular and hearing functions. ^[1]

Benign paroxysmal positional vertigo (BPPV) is believed to be the most common vestibular condition. A lack of vitamin D could be one of the reasons behind its development. Recurrent positional vertigo attacks are known as BPPV. One of the recognized explanations for the cause of BPPV is calcium carbonate crystals getting dislodged from the utricle and moving into the semicircular canals, most frequently the posterior canal. The metabolism of calcium is largely influenced by vitamin D, which may have an impact on the density of calcium carbonate crystals (otoconia). ^[2]

According to recent research, treating Vitamin D insufficiency in Meniere's disease cases, which have been diagnosed newly, reduced the need for intratympanic gentamicin ablative therapy ^[1]. It has long

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been believed that one of the pathogenetic pathways behind Meniere's illness is autoimmunity. The ultrastructural organization of the blood-labyrinthine barrier may be harmed by inflammatory cytokines and chemokines akin to those observed in autoimmune inner ear diseases. This could lead to a pathological increase in vascular permeability and exacerbate Meniere's disease.^[3] Conversely, it is well known that Vitamin D generally has immunomodulatory properties and inhibits the operation of the adaptive immune system.

Additionally, some data suggest inflammation is a major factor in the development and course of vestibular neuritis. Peripheral vestibular dysfunction is frequently caused by vestibular neuritis (VN), which is considered an abrupt onset of nausea, vertigo, and vomiting in the absence of auditory or other neurological symptoms. Studies have shown that during episodes, the mean neutrophil-to-lymphocyte ratio and several acute inflammatory response markers, including C-reactive protein, fibrinogen, and D-dimers, are markedly higher in VN patients.^[4] Given the critical function that vitamin D plays in regulating immunological and inflammatory processes, some research has indicated that individuals with VN had a higher percentage of 25 (OH) D deficits.

Literature survey- A case-control study conducted by Saleh *et al.* among 214 patients in the ENT Department of the University of Ain Shams with 107 patients suffering from common audio-vestibular disorders showed significantly lower levels of serum 25(OH) D₃ levels in BPPV patients compared to the control group (mean serum 25(OH)D₃ level 12.48±6.65 ng/ml)^[1]. In 2021, another case-control study conducted by Abdelmaksoud *et al.* in Egypt showed a correlation between recurrent attacks of BPPV and low vitamin D levels (average value-12.4±2 ng/ml). Vitamin D serum levels increased with a mean level of (26.3±4.1) in the group (group A), which received 6 months of treatment and Vitamin D therapy, with the mean value of recurrence as (0.2±0.4) within 6 months when compared to (1.5±0.7) in the group with no vitamin D supplementation^[2].

Prospective research conducted in the Neurology department of Hwa Mei Hospital by Wu *et al.*^[4] evaluated serum 25(OH) D₃ levels in patients with Vestibular Neuritis for the first time. The study conducted among 59 patients showed that levels of

25(OH) D₃ in patients with vestibular neuritis were lower (19.01±6.53) than in controls (22.94±6.74 ng/ml, p<0.001)^[4]. The prevalence of vitamin D insufficiency was higher in patients with vestibular neuritis.

There was no correlation between vitamin D insufficiency and Meniere's illness, according to the study by Marwa Saleh's. Mehdi Bakashee *et al.* conducted a case-control study at Ghaem University Hospital in Mashhad, Iran in 2019. The study revealed that the case group had a lower mean vitamin D level (18.9±9.7 ng/ml) than the control group (25.2±13.7 ng/ml) with a significant p-value (p=0.027). The difference in Vitamin D serum levels was significant between the two groups^[5]. The study aims to determine the association between serum Vitamin D levels and common vestibular disorders.

MATERIALS AND METHODS

The current study was conducted for three months on 100 patients who presented to the outpatient department of ENT of the tertiary healthcare hospital with complaints of positional vertigo.

Inclusion criteria- The trial included all male and female patients over the age of 18 who provided informed consent in writing. The study was carried out with the permission of the institutional ethics committee. All the subjects underwent a detailed history taking and an audiological and vestibular examination. The diagnosis of vestibular disorder was made based on different criteria as follows:

Patients with the following were **excluded**:

- 1) Non-cooperation;
- 2) History of head and ear trauma
- 3) On long-term Vitamin D therapy, steroid treatment, or osteoporosis treatment
- 4) Any chronic disease, such as chronic liver disease, chronic renal failure, or systemic and hormonal disorders affecting Vitamin D concentrations.

All the participants underwent laboratory investigations like a complete blood count and measurement of 25-hydroxyvitamin D₃, using a chemiluminescence immunoassay. The 25(OH) D level is categorized as normal (30 ng/ml), insufficient (20 to <30 ng/ml), and deficient (<20 ng/ml) based on the internal standard.

Vestibular neuritis- Sustained vertigo of acute or subacute onset (i.e. an acute vestibular syndrome) of moderate to severe intensity with symptoms lasting for at least 24 hours with spontaneous peripheral vestibular nystagmus generally horizontal-torsional not accounted by any other disease ^[6,7].

Benign Paroxysmal Positional Vertigo- Episodes of recurrent vertigo or dizziness caused by turning over or lying down in the supine position, lasting less than 1

RESULTS

In this study, 100 subjects were recruited in total. Of the 100 subjects, 54 were female and 46 were male. The range of age in the study population was from 25 to 66 years, with 46.9 years being the mean age of the group. The study group was separated into two age groups: 25-

minute, with torsional nystagmus elicited by Dix Hallpike technique ^[2].

Meniere’s disease- Criteria established by the International Classification Committee for Vestibular Disorders of the Bárány Society, 2015 ^[8].

Statistical Analysis- All acquired data was entered into a Microsoft Excel spreadsheet and statistically analyzed using the Chi-square, t-test, and ANOVA tests. A p-value of <0.05 was considered statistically significant.

50 and 50-70 years of age, and no significant differences in age distribution or sex ratio were found (Table 1). Among the study subjects, the majority were diagnosed with benign positional paroxysmal vertigo, i.e., 80%, while Meniere’s disease was 12% and vestibular neuritis was 8% (Table 2 and Fig. 1).

Table 1: Demographic data: Age and sex distribution in the study population

Age Groups	Sex	
	Female	Male
25-50 yrs	32	27
50-70 yrs	22	19
Total	54	46

Table 2: Clinical entities in the study group

Disease Groups	Number of patients
BPPV	80
Meniere’s disease	12
Vestibular neuritis	8

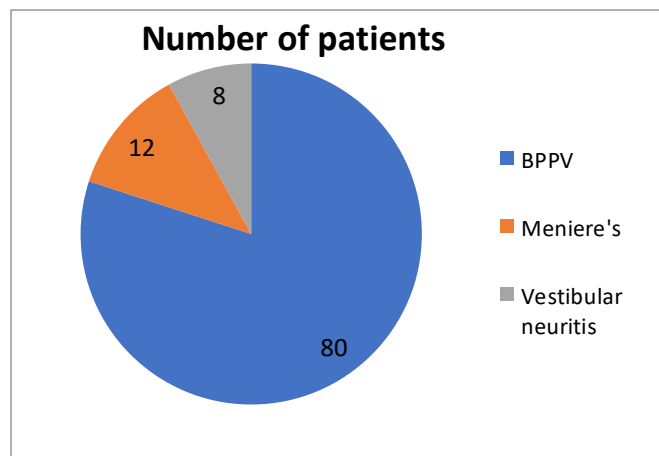


Fig. 1: Distribution of diseases in the study subjects

Deficient levels of serum Vitamin D were found in 41% of the females and 37% of the males. Among the study subjects between 25–50 years of age, 43% had vitamin D deficiency, while within the age fraction of 50–70 years, it

was 35%. There was no significant relationship between age, gender, and serum vitamin D levels in this investigation (Table 3).

Table 3: Demographic distribution of serum vitamin D levels

Demographic distribution		Serum Vit D (ng/ml)			t-value	p-value
		Deficiency	Insufficient	Normal		
Age Group	25-50 yrs	43	12	4	1.61	0.11
	50-70 yrs	35	4	2		
Gender	Female	41	10	3	1.07	0.28
	Male	37	6	3		

In this study, the incidence of BPPV was seen more in females (46%) than males (34%), while Meniere's was diagnosed marginally more in males than in females. Patients in the younger age group had a higher

prevalence of all three disease types than those in the older age group. Table 4 demonstrates a statistically significant variation in serum vitamin D levels across the various groups ($p < 0.05$) (Table 4).

Table 4: Demographic distribution of the common vestibular diseases

Demographic distribution		Diagnosis		
		BPPV	Meniere's	Vestibular neuritis
Age Group	1. 25-50 yrs	44	8	7
	2. 50-70 yrs	36	4	1
Gender	1. Female	46	5	3
	2. Male	34	7	5

The participants diagnosed with BPPV showed the lowest serum vitamin D values with a mean of 14.49 ± 5.94 ng/ml, followed by Meniere's disease with a mean serum vitamin D value of 16.93 ± 6.74 ng/ml both of which were

< 20 ng/ml and were categorized as deficient. The mean serum vitamin D level for participants with vestibular neuritis was 21.69 ± 7.58 ng/ml, which was seen as insufficient (20-30 ng/ml) serum vitamin D levels.

Table 5: Serum Vitamin D3 level in study group according to disease groups

Disease Groups	Serum Vitamin D3 (in ng/ml)			‘f’ value	p-value
	Number	Mean	Std Deviation		
BPPV	80	14.49	5.94	5.40	0.006
Meniere's disease	12	16.93	6.74		
Vestibular neuritis	08	21.69	7.58		

DISCUSSION

The goal of this cross-sectional study was to inspect the relationship between various vestibular diseases and vitamin D deficiency. The current research showed a connection between decreasing 25-OH D3 levels and BPPV. Those with BPPV had considerably lower 25(OH)D3 levels in their serum than those in the other

two disease categories. The results of this study were like the study of Abdelmaksoud *et al.* [6] Because Vitamin D alters the size and density of otoconia, it has been proposed that Vitamin D plays a part in the etiology of BPPV. The two components of otoconia crystals are an outer zone composed of glycoproteins and a central core composed of calcium carbonate. The dynamic calcium



metabolic activity of the vestibular organ forms the otoconia crystals [2,7-9].

One of the secosteroid hormones, Vitamin D, is primarily produced in the dermis and directly affects the production of otoconial particles in the vestibular system due to its effect on the process of calcium and phosphate deposition [4,10]. The disruption of calcium and vitamin D metabolism, which impacts the biomineralization of otoconia as well as bone, is likely the primary factor in the pathophysiology of BPPV [4]. It has been suggested that otoconia lose their fine, stony appearance and form massive crystals, causing them to get detached from the otoconial membrane [11,12]. The recurrence of BPPV has been linked to deficient levels of vitamin D in several studies, together with one by Büki *et al.* [4].

This study also established that patients with Meniere's disease had an average serum vitamin D₃ level that was deficient (16.93±6.74 ng/ml). In a 2019 case-control study, Mehdi *et al.* [3] concluded that Vitamin D levels for Meniere's patients were significantly decreased; however, Marwa *et al.* produced contradictory findings. It has previously been suggested that the physiopathology of Meniere's illness may be explained by autoimmune disease and inflammation brought on by prior viral infections [13]. Vitamin D inhibits the adaptive immune system and is known to have immunoregulatory properties [14]. The transcription of pro-inflammatory mediator genes, such as cyclooxygenases or 5-lipoxygenases, and their contact with transcription factors, such as NF-kappaB, are thought to be altered by vitamin D, and this is what causes inflammatory responses [5,15]. The study's limitation was the small number of patients with Meniere's disease.

A very small proportion of study participants had vestibular neuritis, and the average serum vitamin D level was found to be insufficient (21.69±7.58 ng/ml). Pro-inflammatory mediator levels may rise due to a drop in Vitamin D levels, which would impair the vestibular organ's microvascular perfusion and result in nerve entrapment, edema, and loss of function [5,16]. It is logical to conclude that this condition is influenced by disruptions in the amount of vitamin D. To fully understand the precise impact that Vitamin D plays in the pathophysiology of vestibular neuritis, more research is required.

CONCLUSIONS

In conclusion, this study showed a statistically significant relationship between serum vitamin D levels and Benign Paroxysmal Positional Vertigo. Deficiency of Vitamin D is prevalent in people suffering from BPPV and Meniere's disease. We can emphasize that decreased levels of Vitamin D may play a role in the pathogenesis of certain vestibular disorders. Nonetheless, to clarify the specific role of vitamin D and its deficiency in the genesis of these common vestibular disorders further in-depth research is required.

Further studies can be carried out to determine the prevalence of vestibular disorders with vitamin D deficiency, the role of supplementation of vitamin D₃ in treatment and the reduction of recurrence. Major restrictions of the study were the observational study design, the absence of measurement of other factors like bone mineral density or inflammatory markers, and the small sample size.

CONTRIBUTION OF AUTHORS

Research concept-D. Ravi, Balaji NK, Stuti Mukherjee

Research design- D. Ravi, Balaji NK, Stuti Mukherjee

Supervision-D. Ravi

Materials-D. Ravi, Balaji NK, Stuti Mukherjee

Data collection-D. Ravi, Balaji NK, Stuti Mukherjee

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Critical review-D. Ravi

Article editing-D. Ravi, Balaji NK, Stuti Mukherjee

Final approval-D. Ravi

REFERENCES

- [1] Saleh M, Kamal NM, Ibrahim A, Maksoud A, Taha HM, Belasy KM. Role of vitamin d deficiency in hearing and vestibular disorders. *Ain Shams Med J.*, 2022; 73: 223-30.
- [2] Abdelmaksoud AA, Fahim DFM, Bazeed SES, Alemam MF, Aref ZF. Relation between vitamin D deficiency and benign paroxysmal positional vertigo. *Sci Rep.*, 2021; 11(1): 16855. doi: 10.1038/s41598-021-96445-x.
- [3] Mehdi B, Jünger H, Lundberg YW. Vitamin D supplementation may improve symptoms in Meniere's disease. *Med Hypotheses*, 2018; 116: 44–46. doi: 10.1016/j.mehy.2018.04.019.



- [4] Wu Y, Hu Z, Cai M, Fan Z, Han W, et al. Decreased 25-hydroxyvitamin D levels in patients with vestibular neuritis. *Front Neurol.*, 2019; 10: 863. doi: 10.3389/fneur.2019.00863.
- [5] Bakhshae M, Moradi S, Mohebi M, Ghayour-Mobarhan M, Sharifan P, et al. Association between serum vitamin D level and ménière's disease. *Otolaryngol Head Neck Surg.*, 2022; 166(1): 146–50. doi: 10.1177/01945998211000395.
- [6] Abdelmaksoud AA, Fahim DFM, Bazeed SES, Alemam MF, Aref ZF. Relation between vitamin D deficiency and benign paroxysmal positional vertigo. *Sci Rep.*, 2021; 11(1): 16855. doi: 10.1038/s41598-021-96445-x.
- [7] Strupp M, Bisdorff A, Furman J, Hornibrook J, Jahn K, Maire R, Newman-Toker D, Magnusson M. Acute unilateral vestibulopathy/vestibular neuritis: Diagnostic criteria. *J Vestib Res.* 2022; 32(5): 389-406. doi: 10.3233/VES-220201.
- [8] Bae CH, Na HG, Choi YS. Current diagnosis and treatment of vestibular neuritis: a narrative review. *J Yeungnam Med Sci.*, 2022; 39(2): 81–88. doi: 10.12701/yujm.2021.01228.
- [9] de Pont LMH, van Steekelenburg JM, Verbist BM, van Buchem MA, Blom HM, et al. State of the art imaging in Ménière's disease. Tips and tricks for protocol and interpretation. *Curr Radiol Rep.*, 2020; 811. doi: 10.1007/s40134-020-00365-z.
- [10] Lundberg YW, Zhao X, Yamoah EN. Assembly of the otoconia complex to the macular sensory epithelium of the vestibule. *Brain Res.*, 2006; 1091(1): 47-57. doi: 10.1016/j.brainres.2006.02.083.
- [11] Pillai NG, Gopinath I. A prospective analysis of vitamin D and recurrent benign paroxysmal positional vertigo. *Int J Otorhinolaryngol Head Neck Surg.*, 2019; 5(6): 1548. doi: 10.18203/issn.2454-5929.ijohns20194924.
- [12] Yang H, Zhao X, Xu Y, Wang L, He Q, et al. Matrix recruitment and calcium sequestration for spatial-specific otoconia development. *PLoS One*, 2011; 6(5): e20498. doi: 10.1371/journal.pone.0020498.
- [13] Jeong SH, Kim JS, Shin JW, Kim S, Lee H, et al. Decreased serum vitamin D in idiopathic benign paroxysmal positional vertigo. *J Neurol.*, 2013; 260(3): 832–88. doi: 10.1007/s00415-012-6712-2.
- [14] Kim SH, Kim JY, Lee HJ, Gi M, Kim BG, et al. Autoimmunity as a candidate for the etiopathogenesis of Meniere's disease: detection of autoimmune reactions and diagnostic biomarker candidate. *PLoS One*, 2014; 9(10): e111039. doi: 10.1371/journal.pone.0111039.
- [15] Bikle DD. Vitamin D metabolism, mechanism of action, and clinical applications. *Chem Biol.* 2014; 21(3): 319–29. doi: 10.1016/j.chembiol.2013.12.016.
- [16] Wöbke TK, Sorg BL, Steinhilber D. Vitamin D in inflammatory diseases. *Front Physiol.*, 2014; 5: 244.

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