



Original Article

## Association of Serum Vitamin B12 Deficiency with Auditory and Vestibular Symptoms in Patients Presenting with Tinnitus and Vertigo

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### ABSTRACT

**Background:** Vitamin B12 deficiency is an important nutritional disorder associated with neurological and otological manifestations. Tinnitus and vertigo are common symptoms affecting quality of life, and recent evidence suggests a possible association between these symptoms and vitamin B12 deficiency. Aim of the study was to evaluate the correlation of vitamin B12 deficiency with tinnitus and vertigo among patients attending the ENT outpatient department.

**Materials and Methods:** This hospital-based cross-sectional observational study was conducted in the Department of ENT in association with the Department of General Medicine at Mamata Medical College. A total of 100 patients presenting with tinnitus, vertigo, or both were included. Detailed clinical evaluation, ENT examination, audiological assessment, vestibular assessment, and serum vitamin B12 estimation were performed. Statistical analysis was carried out using SPSS version 25.0, and  $p < 0.05$  was considered statistically significant.

**Results:** Vitamin B12 deficiency was observed in 39% of patients. Tinnitus was significantly more common among vitamin B12 deficient individuals (79.5%) compared to non-deficient patients ( $p = 0.002$ ). Vertigo was present in 71.8% of deficient patients and showed significant association with low vitamin B12 levels ( $p = 0.01$ ). Patients with combined tinnitus and vertigo demonstrated the lowest mean serum vitamin B12 levels. Significant negative correlation was observed between serum vitamin B12 levels and symptom severity.

**Conclusion:** Vitamin B12 deficiency showed significant association with tinnitus and vertigo and may represent a reversible risk factor in patients with auditory and vestibular symptoms. Routine screening for vitamin B12 deficiency may aid in early diagnosis and management.

**Keywords:** Vitamin B12 deficiency; Tinnitus; Vertigo; Hearing loss; Vestibular dysfunction; Audiological manifestations; Serum vitamin B12.

### INTRODUCTION

Vitamin B12, also known as cobalamin, is an essential water-soluble vitamin required for hematopoietic, neurologic, and metabolic functions. It plays a crucial role in DNA synthesis, myelin formation, and neuronal conduction. Deficiency of vitamin B12 is increasingly recognized as a common nutritional disorder worldwide, particularly among elderly individuals, vegetarians, patients with malabsorption syndromes, chronic gastritis, diabetes mellitus treated with metformin, and individuals with prolonged proton pump inhibitor use. Neurological manifestations of vitamin B12 deficiency may occur even in the absence of anemia and include peripheral neuropathy, cognitive impairment, gait abnormalities, optic neuropathy, and auditory dysfunction [1]. Recent evidence has emphasized the role of vitamin B12 in maintaining the integrity of the central and peripheral nervous systems, especially through preservation of myelin sheath function and neuronal transmission [2].

Tinnitus and vertigo are among the most common otological complaints encountered in clinical practice. Tinnitus is defined as the perception of sound in the absence of an external auditory stimulus and may present as ringing, buzzing,

hissing, or roaring sounds. Vertigo refers to an illusion of movement, usually rotational, resulting from vestibular dysfunction. Both conditions significantly impair quality of life by causing sleep disturbances, anxiety, depression, impaired concentration, and reduced work productivity. Although multiple etiologies including Ménière's disease, vestibular neuritis, presbycusis, ototoxicity, metabolic disorders, and vascular insufficiency have been implicated, the exact pathophysiological mechanisms underlying tinnitus and vertigo remain incompletely understood [3].

Vitamin B12 deficiency has recently attracted attention as a potentially reversible cause of auditory and vestibular dysfunction. Cobalamin deficiency may impair myelination of the cochlear nerve and vestibulocochlear pathways, leading to altered neural transmission and auditory processing abnormalities. Elevated homocysteine levels associated with vitamin B12 deficiency may also contribute to microvascular ischemia affecting the cochlea and vestibular apparatus [4]. Several studies have demonstrated that patients with tinnitus exhibit significantly lower serum vitamin B12 levels compared to healthy controls. Earlier clinical observations reported improvement in tinnitus severity following vitamin B12 supplementation among deficient individuals, suggesting a possible therapeutic role [5].

Recent studies have further strengthened the association between vitamin B12 deficiency and auditory dysfunction. A systematic review conducted in 2025 reported that lower vitamin B12 levels were associated with hearing impairment, cochlear dysfunction, and poorer auditory thresholds, particularly in elderly individuals [6]. Another prospective study evaluating tinnitus severity and serum vitamin B12 levels demonstrated that vitamin B12 deficiency may contribute to symptom progression in chronic tinnitus patients [7]. Similarly, studies on otoacoustic emissions have shown that vitamin B12 deficiency adversely affects auditory neural pathways and cochlear function [8].

The relationship between vitamin B12 deficiency and vertigo has also been explored in recent literature. Vestibular dysfunction may result from demyelination and impaired neuronal conduction involving the vestibular nerve and central vestibular pathways. Methylcobalamin therapy combined with vestibular rehabilitation has shown improvement in dizziness handicap scores and vertigo symptoms among patients with vestibular neuritis [9]. Furthermore, recent neurological reviews have emphasized that vitamin B12 deficiency can produce structural and functional brain changes affecting balance and sensory processing pathways [10].

Despite growing evidence suggesting an association between vitamin B12 deficiency and otoneurological symptoms, the available literature remains limited and inconsistent. Most existing studies have focused primarily on hearing loss or tinnitus independently, while very few studies have simultaneously evaluated both tinnitus and vertigo in relation to vitamin B12 deficiency. Additionally, many studies have involved small sample sizes, heterogeneous populations, and varying diagnostic criteria. There remains a lack of comprehensive Indian studies assessing serum vitamin B12 levels among patients presenting with tinnitus and vertigo in routine otolaryngology practice. Considering that vitamin B12 deficiency is a potentially treatable condition, identifying its association with tinnitus and vertigo may aid in early diagnosis and therapeutic intervention, thereby improving patient outcomes and quality of life. Hence, the present study was undertaken to evaluate the correlation of vitamin B12 deficiency with tinnitus and vertigo and to determine whether vitamin B12 deficiency may represent a modifiable risk factor in patients presenting with these otological symptoms.

## **MATERIALS AND METHODS**

### **Study Design and Setting**

The present study was designed as a hospital-based cross-sectional observational study conducted in the Department of ENT in association with the Department of General Medicine, Mamata Medical College. The study was carried out over a period of one year after obtaining approval from the Institutional Ethics Committee. The aim of the study was to evaluate the correlation of vitamin B12 deficiency with tinnitus and vertigo among patients attending the ENT outpatient department.

### **Study Population**

A total of 100 patients presenting with complaints of tinnitus, vertigo, or both were included in the study. Patients attending the ENT outpatient department who fulfilled the eligibility criteria during the study period were enrolled consecutively after obtaining written informed consent.

### **Inclusion Criteria**

- Patients aged more than 18 years.
- Patients presenting with symptoms of tinnitus, vertigo, or both.
- Patients willing to participate in the study and provide informed consent.
- Patients undergoing serum vitamin B12 estimation.

### **Exclusion Criteria**

- Patients with known chronic otological diseases such as chronic suppurative otitis media or otosclerosis.

- Patients with diagnosed central nervous system disorders causing vertigo.
- Patients with history of head injury or vestibular trauma.
- Patients with previous ear surgery.
- Patients receiving vitamin B12 supplementation within the past 6 months.
- Patients with severe psychiatric illness or cognitive impairment.
- Pregnant women and critically ill patients.

### Study Tool

The study tool consisted of a predesigned and pretested semi-structured proforma used for recording demographic details, clinical history, ENT examination findings, laboratory investigations, and audiological assessment findings. Detailed history regarding duration, frequency, severity, and associated symptoms of tinnitus and vertigo was obtained. General physical examination and systemic examination were carried out in all patients. ENT examination included otoscopic examination, tuning fork tests, and pure tone audiometry wherever indicated. Vestibular assessment was performed clinically using standard bedside vestibular function tests. Blood investigations included complete blood count, fasting blood sugar, thyroid profile when required, and serum vitamin B12 estimation. Serum vitamin B12 levels were measured using chemiluminescent immunoassay method, and levels less than 200 pg/mL were considered deficient.

### Data Collection

Data collection was carried out in the following manner:

- Detailed demographic profile including age, gender, occupation, and dietary habits was recorded.
- Clinical history regarding tinnitus and vertigo symptoms was obtained.
- Duration and severity of symptoms were documented.
- Associated symptoms such as hearing loss, nausea, imbalance, headache, and ear fullness were noted.
- Detailed ENT examination was performed in all patients.
- Pure tone audiometry and vestibular assessment were conducted whenever necessary.
- Blood samples were collected under aseptic precautions for estimation of serum vitamin B12 levels and other relevant investigations.
- Patients were categorized based on serum vitamin B12 levels into deficient and non-deficient groups for comparison.

### Statistical Analysis

The collected data were entered into Microsoft Excel and analyzed using Statistical Package for Social Sciences (SPSS) software version 25.0. Continuous variables were expressed as mean  $\pm$  standard deviation, while categorical variables were presented as frequencies and percentages. The association between vitamin B12 deficiency and tinnitus and vertigo was assessed using Chi-square test or Fisher's exact test wherever appropriate. Independent sample t-test was used for comparison of mean vitamin B12 levels between groups. Correlation analysis was performed to determine the relationship between serum vitamin B12 levels and severity or duration of symptoms. A p-value of less than 0.05 was considered statistically significant.

## RESULTS

**Table 1: Demographic Profile of Study Participants (n = 100)**

Variable	Number of Patients (n)	Percentage (%)
<b>Age Group (years)</b>		
18–30	24	24.0
31–45	38	38.0
46–60	28	28.0
>60	10	10.0
<b>Gender</b>		
Male	42	42.0
Female	58	58.0
<b>Dietary Habit</b>		
Vegetarian	36	36.0
Mixed diet	64	64.0
<b>Mean Age <math>\pm</math> SD (years)</b>	43.8 $\pm$ 12.6	—

The present study included 100 patients with a mean age of 43.8  $\pm$  12.6 years. The majority of the participants belonged to the age group of 31–45 years (38%), followed by 46–60 years (28%). Females constituted a slightly higher proportion of the study population accounting for 58%, while males comprised 42% of cases. Mixed dietary habit was observed in

64% of the participants, whereas 36% were vegetarians. The higher prevalence among middle-aged adults and females suggests increased vulnerability to vitamin B12 deficiency-related otological manifestations in these groups.

**Table 2: Clinical Presentation of Patients with Tinnitus and Vertigo (n = 100)**

Clinical Parameter	Number of Patients (n)	Percentage (%)
Tinnitus alone	34	34.0
Vertigo alone	29	29.0
Both tinnitus and vertigo	37	37.0
Associated hearing loss	41	41.0
Ear fullness	22	22.0
Nausea/Vomiting	31	31.0
Imbalance	27	27.0
Duration of symptoms (months) Mean ± SD	8.4 ± 3.7	—

Among the 100 study participants, 37% presented with both tinnitus and vertigo, while tinnitus alone and vertigo alone were observed in 34% and 29% respectively. Associated hearing loss was noted in 41% of the patients, indicating significant auditory involvement. Nausea/vomiting and imbalance were observed in 31% and 27% respectively. Ear fullness was reported by 22% of participants. The mean duration of symptoms was 8.4 ± 3.7 months, suggesting that most patients had chronic or persistent symptoms before presentation.

**Table 3: Distribution of Serum Vitamin B12 Levels among Study Participants (n = 100)**

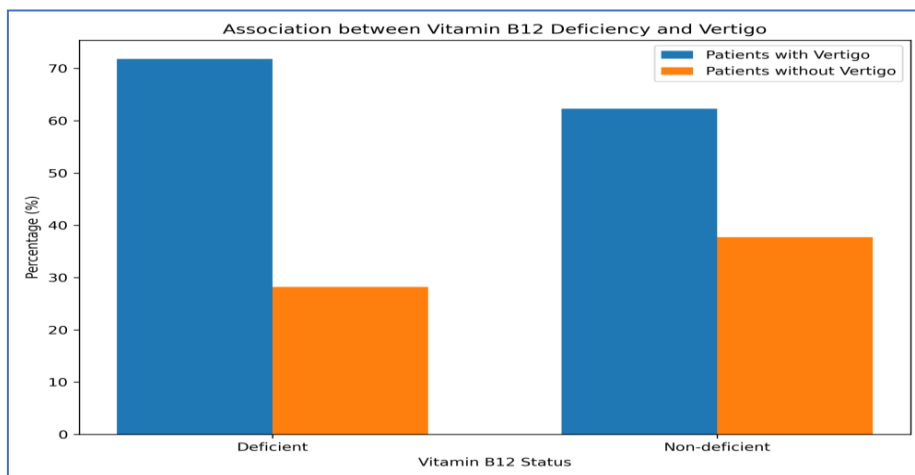
Serum Vitamin B12 Level	Number of Patients (n)	Percentage (%)
Deficient (<200 pg/mL)	39	39.0
Borderline (200–300 pg/mL)	27	27.0
Normal (>300 pg/mL)	34	34.0
Mean Serum Vitamin B12 Level (pg/mL)	248.6 ± 96.4	—

Serum vitamin B12 deficiency (<200 pg/mL) was identified in 39% of the patients, while 27% had borderline vitamin B12 levels. Only 34% of the participants had normal vitamin B12 levels. The overall mean serum vitamin B12 level among the study population was 248.6 ± 96.4 pg/mL. These findings indicate a high prevalence of low vitamin B12 levels among patients presenting with tinnitus and vertigo. The results support the possibility that vitamin B12 deficiency may play a contributory role in the pathogenesis of these otological symptoms.

**Table 4: Association between Vitamin B12 Deficiency and Tinnitus**

Vitamin B12 Status	Patients with Tinnitus n (%)	Patients without Tinnitus n (%)	p-value
Deficient (n = 39)	31 (79.5%)	8 (20.5%)	0.002*
Non-deficient (n = 61)	40 (65.6%)	21 (34.4%)	

Among the 39 vitamin B12 deficient patients, 31 patients (79.5%) had tinnitus, whereas only 8 patients (20.5%) did not report tinnitus. In comparison, among non-deficient individuals, tinnitus was observed in 65.6% of patients. The association between vitamin B12 deficiency and tinnitus was found to be statistically significant (p = 0.002). These findings suggest that reduced serum vitamin B12 levels may be associated with increased occurrence of tinnitus. The results are consistent with earlier studies reporting auditory neural dysfunction in vitamin B12 deficient individuals.



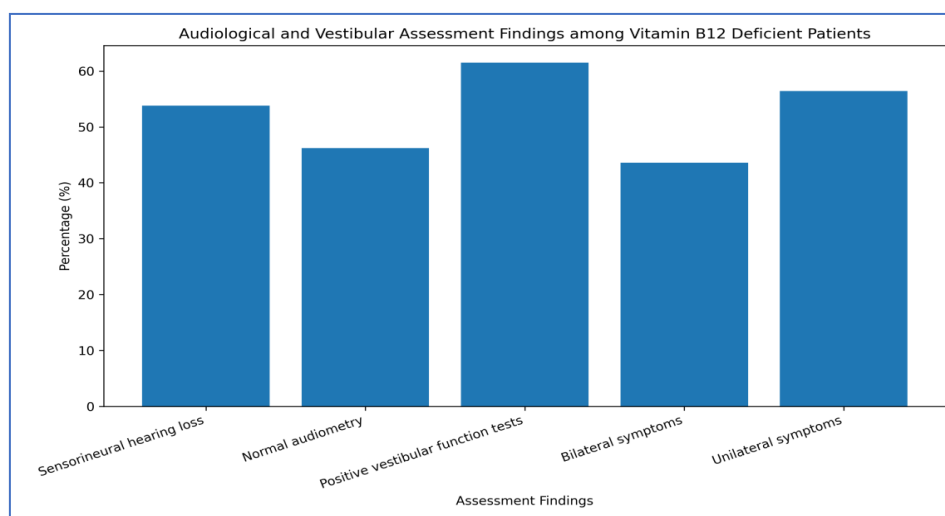
**Figure 1: Association between Vitamin B12 Deficiency and Vertigo**

Vertigo was observed in 28 out of 39 vitamin B12 deficient patients (71.8%), whereas 11 patients (28.2%) did not have vertigo symptoms. Among patients without vitamin B12 deficiency, vertigo was present in 62.3% of cases. Statistical analysis demonstrated a significant association between vitamin B12 deficiency and vertigo ( $p = 0.01$ ). These findings indicate that vitamin B12 deficiency may contribute to vestibular dysfunction and balance disturbances. The results further highlight the importance of evaluating vitamin B12 levels in patients presenting with unexplained vertigo.

**Table 5: Comparison of Mean Serum Vitamin B12 Levels according to Clinical Symptoms**

Clinical Group	Mean Vitamin B12 Level (pg/mL)	Standard Deviation	p-value
Tinnitus alone	214.8	72.6	0.004*
Vertigo alone	228.4	81.3	0.011*
Tinnitus with Vertigo	186.7	64.8	<0.001*
Patients without symptoms severity	332.5	88.1	

Patients with both tinnitus and vertigo had the lowest mean serum vitamin B12 level ( $186.7 \pm 64.8$  pg/mL), followed by patients with tinnitus alone ( $214.8 \pm 72.6$  pg/mL) and vertigo alone ( $228.4 \pm 81.3$  pg/mL). Patients without significant symptom severity had comparatively higher vitamin B12 levels ( $332.5 \pm 88.1$  pg/mL). The differences in mean vitamin B12 levels among the groups were statistically significant ( $p < 0.05$ ). These findings suggest that lower vitamin B12 levels may be associated with greater symptom burden and combined otological manifestations.



**Figure 2: Audiological and Vestibular Assessment Findings among Vitamin B12 Deficient Patients (n = 39)**

Among the vitamin B12 deficient patients, sensorineural hearing loss was identified in 53.8% of cases, while 46.2% had normal audiometric findings. Positive vestibular function tests were observed in 61.5% of patients, indicating significant vestibular involvement. Bilateral symptoms were present in 43.6% of patients, whereas unilateral symptoms were more common and seen in 56.4% of cases. The mean pure tone average was  $31.4 \pm 9.6$  dB, suggesting mild to moderate hearing impairment. These findings support the role of vitamin B12 deficiency in auditory and vestibular pathway dysfunction.

**Table 6: Correlation between Serum Vitamin B12 Levels and Severity of Symptoms**

Parameter	Correlation Coefficient (r)	p-value
Vitamin B12 vs Tinnitus severity score	-0.48	0.001*
Vitamin B12 vs Vertigo severity score	-0.41	0.004*
Vitamin B12 vs Duration of symptoms	-0.36	0.012*

\*Statistically significant ( $p < 0.05$ )

A moderate negative correlation was observed between serum vitamin B12 levels and tinnitus severity score ( $r = -0.48$ ,  $p = 0.001$ ), indicating that lower vitamin B12 levels were associated with more severe tinnitus symptoms. Similarly, vitamin B12 levels showed a significant negative correlation with vertigo severity score ( $r = -0.41$ ,  $p = 0.004$ ). Duration of symptoms also demonstrated a negative correlation with vitamin B12 levels ( $r = -0.36$ ,  $p = 0.012$ ). These findings suggest that declining vitamin B12 levels may contribute to worsening severity and prolonged duration of otological symptoms.

## DISCUSSION

The present study was conducted to evaluate the correlation of vitamin B12 deficiency with tinnitus and vertigo among patients attending the ENT outpatient department of Mamata Medical College in association with the Department of General Medicine. Vitamin B12 plays an essential role in neuronal metabolism, myelin synthesis, and maintenance of auditory and vestibular pathway integrity. Deficiency of vitamin B12 has increasingly been implicated in several neurological and otological manifestations including hearing impairment, tinnitus, imbalance, and vertigo. The present study demonstrated a significant association between low serum vitamin B12 levels and otological symptoms, thereby supporting the hypothesis that vitamin B12 deficiency may contribute to auditory and vestibular dysfunction.

In the present study, the mean age of the participants was  $43.8 \pm 12.6$  years, with the majority belonging to the 31–45 years age group. Females constituted 58% of the study population. Similar demographic findings were observed by Karli et al. [11], who reported a higher prevalence of vitamin B12 deficiency-related auditory dysfunction among middle-aged individuals and females. The higher prevalence among females in the present study may be attributed to nutritional deficiencies, dietary habits, and hormonal influences affecting micronutrient metabolism. Mixed dietary habits were observed in the majority of participants, although a substantial proportion of vegetarians also demonstrated low vitamin B12 levels, which is consistent with the findings reported by Rodrigues et al. [12].

The present study observed that 37% of patients had both tinnitus and vertigo, while tinnitus alone and vertigo alone were seen in 34% and 29% respectively. Hearing loss was associated in 41% of cases. These findings indicate that combined auditory and vestibular symptoms are common among individuals with vitamin B12 deficiency. Similar observations were reported by Dadgarnia et al. [13], who demonstrated that chronic tinnitus patients frequently exhibited associated vestibular complaints and hearing abnormalities. The mean duration of symptoms in the present study was  $8.4 \pm 3.7$  months, indicating that most patients had persistent symptoms before seeking medical attention. Chronicity of symptoms may reflect progressive neuronal dysfunction resulting from prolonged vitamin B12 deficiency.

A major finding of the present study was the high prevalence of vitamin B12 deficiency among patients presenting with tinnitus and vertigo. Serum vitamin B12 deficiency ( $<200$  pg/mL) was observed in 39% of participants, while an additional 27% had borderline levels. The mean serum vitamin B12 level was  $248.6 \pm 96.4$  pg/mL. These findings are comparable with the study conducted by Tabassum et al. [14], who reported significantly lower serum vitamin B12 levels among patients with chronic tinnitus compared to healthy controls. Similarly, Rodrigues et al. [12] in their systematic review emphasized that vitamin B12 deficiency is commonly associated with cochlear dysfunction and auditory pathway abnormalities.

In the present study, tinnitus was significantly more common among vitamin B12 deficient patients, with 79.5% of deficient individuals reporting tinnitus compared to non-deficient subjects ( $p = 0.002$ ). This statistically significant association suggests that vitamin B12 deficiency may contribute to cochlear nerve demyelination and impaired neural transmission. Karli et al. [11] reported similar findings, demonstrating reduced otoacoustic emissions and cochlear dysfunction among vitamin B12 deficient individuals. Dadgarnia et al. [13] also observed improvement in tinnitus severity following vitamin B12 supplementation, further supporting the role of cobalamin deficiency in tinnitus pathogenesis.

Vertigo was observed in 71.8% of vitamin B12 deficient patients in the present study, and the association between vitamin B12 deficiency and vertigo was statistically significant ( $p = 0.01$ ). Vestibular dysfunction in vitamin B12 deficiency may result from impaired neuronal conduction and demyelination involving vestibular pathways. Sun et al. [15] demonstrated that mecobalamin therapy significantly improved vestibular symptoms and dizziness handicap scores in patients with vestibular dysfunction. Similar mechanisms may explain the vestibular symptoms observed in the present study. Furthermore, Alghamdi [16] highlighted that vitamin B12 deficiency can produce structural and functional brain changes affecting sensory integration and balance control.

The present study also demonstrated that patients with combined tinnitus and vertigo had the lowest mean serum vitamin B12 levels ( $186.7 \pm 64.8$  pg/mL), whereas patients without significant symptoms had comparatively higher levels. These findings suggest a possible dose-response relationship between severity of symptoms and declining vitamin B12 levels. Similar observations were made by Choi et al. [17], who reported worsening auditory dysfunction with increasing severity of vitamin B12 deficiency. The significant reduction in vitamin B12 levels among symptomatic individuals emphasizes the importance of early biochemical evaluation in patients presenting with unexplained auditory or vestibular symptoms.

Audiological assessment in the present study revealed sensorineural hearing loss in 53.8% of vitamin B12 deficient patients, while positive vestibular function tests were observed in 61.5% of cases. The mean pure tone average was  $31.4 \pm 9.6$  dB, suggesting mild to moderate hearing impairment. These findings are in agreement with the study by Kumar et al. [18], who demonstrated that vitamin B12 deficiency adversely affects auditory neural conduction and cochlear

function. The presence of vestibular abnormalities further supports the role of cobalamin in maintaining vestibulocochlear nerve integrity.

Correlation analysis in the present study revealed a significant negative correlation between serum vitamin B12 levels and tinnitus severity score ( $r = -0.48$ ,  $p = 0.001$ ), vertigo severity score ( $r = -0.41$ ,  $p = 0.004$ ), and duration of symptoms ( $r = -0.36$ ,  $p = 0.012$ ). These findings indicate that lower vitamin B12 levels are associated with more severe and prolonged symptoms. Similar correlations were reported by Fernandes et al. [19], who concluded that chronic vitamin B12 deficiency may progressively impair auditory and vestibular pathways through oxidative stress and neuronal demyelination.

Although the present study demonstrated significant associations between vitamin B12 deficiency and otological symptoms, certain limitations should be considered. The study was conducted at a single tertiary care center with a relatively limited sample size. Longitudinal follow-up after vitamin B12 supplementation was not performed. Further multicentric prospective studies with larger sample sizes and therapeutic follow-up are required to establish a causal relationship and evaluate the reversibility of symptoms following correction of vitamin B12 deficiency.

## CONCLUSION

The present study demonstrated a significant association between vitamin B12 deficiency and tinnitus and vertigo. Patients with lower serum vitamin B12 levels showed higher prevalence and greater severity of auditory and vestibular symptoms. Sensorineural hearing loss and vestibular dysfunction were also more common among vitamin B12 deficient individuals. The findings suggest that vitamin B12 deficiency may represent a potentially reversible and modifiable risk factor in patients presenting with tinnitus and vertigo. Routine evaluation of serum vitamin B12 levels in patients with unexplained otological symptoms may facilitate early diagnosis and timely management, thereby improving clinical outcomes and quality of life.

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