

Clinico Audiological Profile of Idiopathic Tinnitus Patients and Its Association with Vitamin B₁₂ Levels: A Cross-Sectional Study in a Tertiary Care Hospital in Mandya.

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Abstract

Background: The impact of tinnitus in daily life is highly variable. Tinnitus can be bothersome and persistent. Cochlear function is dependent on adequate vascular supply and normal functioning of nerve tissue. Vitamin B₁₂ is an important co-factor in basic myelin protein synthesis. Hence it needs to find out the relation between vitamin B₁₂ with tinnitus so that curative measures can be taken to improve the quality of life.

Materials and Methods: A cross-sectional study was conducted at our tertiary care centre for a period of 6 months among 63 patients with idiopathic tinnitus. Tinnitus severity was evaluated subjectively by Tinnitus Severity Index (TSI). Tinnitus loudness was assessed by visual analogue scale. Visual analogue scale score was performed by asking patient to rate the loudness of tinnitus from 0 to 10. Pure Tone Audiometry was performed as a part of audiological examination. Blood samples were taken from all patients to analyse serum vitamin B₁₂ levels.

Results:

Tinnitus was found to be unilateral in 54% of cases (right ear in 56% and left ear in 44% of these cases) and bilateral in 46% of cases. According to Tinnitus severity index, 36.5% were categorized as very mild, 26.98% as mild, 22.4% as moderate, 9.5% as severe and 4.62% as catastrophic. Out of this, 36.58% of very mild, 26.8% of mild, 22% of moderate, 9.75% of severe and 4.87% of catastrophic tinnitus severity had vitamin B₁₂ deficiency. The average score for TSI was 22.4. The mean tinnitus loudness measured by visual analogue scale was 6.38. 64.3 % (41) had low vitamin B₁₂ levels and 35.7 % (22) had normal levels. The mean serum vitamin B₁₂ level was 211 ± 98 pg/ml, with maximum level was 679 pg/ml and minimum level was 80 pg/ml.

Conclusion: Association of serum vitamin B₁₂ in patients with idiopathic tinnitus was significant in this study. More studies should be performed to assess if vitamin B₁₂ supplementation may be beneficial to tinnitus patients. Based on our study, there is enough evidence to recommend serum vitamin B₁₂ assessment in all tinnitus patients. Appropriate intervention improves the quality of life.

Key Word: Idiopathic tinnitus, vitamin B₁₂, audiological profile, association, tinnitus severity index.

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I. Introduction

Tinnitus is the perception of sound in the absence of external source.⁽¹⁾ Tinnitus is defined as the “conscious expression of a sound that originates in an involuntary manner in the head of its owner or may appear to the person to do so” by McFadden.⁽²⁾ Tinnitus may be unilateral or bilateral and can be perceived as arising from within or outside the head.⁽³⁾ Approximately 10 to 15% of the population complains of tinnitus.⁽⁴⁾ It is most common among elderly individuals aged 60 years and above.⁽⁵⁾ 85% of patients presenting with ear related symptoms experiencing tinnitus as well.⁽⁴⁾ The characteristics of tinnitus perception vary with ringing, buzzing, clicking and pulsations. Tinnitus can be associated with several causes and exacerbating factors.⁽¹⁾ The various etiologies for tinnitus are cerumen impaction, otosclerosis, turbulent blood flow in an intracranial vessel, trauma, auditory hallucinations, vestibular schwannoma and increased blood flow in glomus jugular tumor.⁽¹⁾ Tinnitus can occur in association with sensorineural hearing loss (age related, ototoxins, noise induced or idiopathic).⁽¹⁾

Vitamin B₁₂ is a co-enzyme that plays role in metabolic functions in normal cell growth and DNA synthesis. Vitamin B₁₂ is an important co-factor in basic myelin protein synthesis. Deficiency of vitamin B₁₂ is associated with axonal degeneration, demyelination and subsequent neuronal death.⁽⁶⁾ Cochlear function is dependent on adequate vascular supply and normal functioning of nerve tissue. Homocysteine which elevated

during vitamin B₁₂ and folate deficiency is considered as vascular toxin and neurotoxin.⁽⁷⁾ Vitamin B₁₂ deficiency may lead to demyelination of neurons in the cochlear nerve and resulting in hearing loss.⁽⁸⁾ Deficiency of vitamin B₁₂ results in destruction of microvasculature of stria vascularis which might result in decreased endocochlear potential and in hearing loss and tinnitus.⁽⁷⁾

The impact of tinnitus in daily life is highly individualised. Tinnitus can be bothersome and persistent. Hence it needs to find out the relation between vitamin B₁₂ with tinnitus so that curative measures can be taken to improve quality of life. The role of diet in control of tinnitus has been identified as research priority by both clinicians and patients.⁽⁹⁾

Therefore, this study has been taken up for understanding the clinico-audiological profile of patients with idiopathic tinnitus and its association with vitamin B₁₂ levels among the out-patient and in-patient department at tertiary care hospital, Mandya.

II. Material And Methods

This was a cross-sectional type of study conducted at tertiary care centre for a period of 6 months from December 2023 to May 2024. Data collection was started after approval from the Institutional Ethics Committee of Mandya Institute of Medical Sciences. Informed written consent was taken from the study subjects after explaining to them the plan and intention of the study in the language best known to them.

Study Design: Cross-sectional study

Study Location: Department of Otorhinolaryngology at Mandya Institute of Medical Sciences, Mandya, Karnataka, India.

Study Duration: December 2023 to May 2024

Sample size: 63

Sample size calculation:

Sample size is calculated by using formula.

Based on one of the previous studies the proportion (p) of people experienced tinnitus sometimes was 86% among adult Indian population. (Study by Sajana Aryal, Yoshita Sharma and Prashanth Prabhu).⁽¹⁰⁾

Sample size (N) = $Z_{\alpha/2}^2 \cdot p \cdot q / l^2$

Z = standard normal variate (1.96)

P = proportion of people experienced tinnitus sometimes = 86⁽¹⁰⁾

q = 1 - p = 14

Relative error l = 10% of p = 8.6

N = $1.96 \times 1.96 \times 86 \times 14 / 8.6^2 = 62.5$

Rounded off to 63.

Hence, sample size is 63.

Subjects and selection method: The study population was patients aged above 18 years presented to Department of Otorhinolaryngology at Mandya Institute of Medical Sciences with idiopathic tinnitus.

Inclusion Criteria:

- Patients presenting with tinnitus aged above 18 years at Department of Otorhinolaryngology, Mandya Institute of Medical Science, Mandya.
- Patients willing to give informed written consent to participate in the study. (>18 years)

Exclusion Criteria:

- Patients with history of intake of ototoxic drugs.
- Patients with family history of hearing loss.
- Patients with noise induced hearing loss.
- Patients with history of ear surgery and ear diseases.

Procedure methodology

A specially designed proforma was used to collect data of each individual patient visiting Otorhinolaryngology department with complaint of tinnitus. Demographic data like age, sex and occupation of the patient were noted. Past medical and surgical history with focus on otologic or neurosurgical procedures, intracranial infections, head trauma, autoimmune disease and psychiatric illness were obtained. History regarding hypertension, diabetes mellitus, cardiovascular disease, valvular heart disease, vascular stenosis and vascular lesions were also obtained. History regarding tobacco chewing, smoking and alcohol consumption were also asked. A thorough otological and audiological examination was carried out in all patients.

Patients were evaluated according to the characteristics of tinnitus such as sounding pattern, laterality, duration of symptom and hearing loss. Severity of tinnitus was measured using tinnitus severity scale. Patients were also asked about associated symptoms such as disturbance of sleep, mood and cognitive difficulties. Tinnitus severity was evaluated subjectively by Tinnitus Severity Index (TSI). Tinnitus severity index is an assessment questionnaire with 12 questions. Patients were assessed on the basis of 60 points. TSI is an efficient indicator of negative impacts of tinnitus upon patients.

Table no 1. Tinnitus Severity Index (TSI)⁽¹¹⁾

DIRECTIONS: For the questions below, please CIRCLE the number that best describes you					
Does your tinnitus	Never	Rarely	Sometimes	Usually	Always
1. Make you feel irritable or nervous?	1	2	3	4	5
2. Make you feel tired or stressed?	1	2	3	4	5
3. Make it difficult for you to relax?	1	2	3	4	5
4. Make it uncomfortable to be in a quiet room?	1	2	3	4	5
5. Make it difficult to concentrate?	1	2	3	4	5
6. Make it harder to interact pleasantly with others?	1	2	3	4	5
7. Interfere with your <i>required</i> activities? (Work, home, care, or other responsibilities)	1	2	3	4	5
8. Interfere with your social activities or other things you do in your leisure time?	1	2	3	4	5
9. Interfere with your overall enjoyment of life?	1	2	3	4	5
10. Interfere with your ability to sleep?	1	2	3	4	5
11. How often do you have difficulty ignoring your tinnitus?	1	2	3	4	5
12. How often do you experience discomfort from tinnitus?	1	2	3	4	5

Table no 2: Severity range of TSI score⁽¹¹⁾

RANGE OF SCORE	SEVERITY
1-12	Very mild
13-24	Mild
25-36	Moderate
37-48	Severe
49-60	Catastrophic

Tinnitus loudness was assessed by visual analogue scale. Visual analogue scale score was performed by asking patient to rate the loudness of tinnitus from 0 to 10. The physical examination including eye, musculoskeletal, neurologic system focusing on cranial nerves and cerebellar function were performed. Pure Tone Audiometry was performed as a part of audiological examination. It was conducted for frequencies at octave intervals from 250 to 8000 Hz for both air and bone conduction. Computed tomography, computerized tomographic angiography/ venography, magnetic resonance imaging and magnetic resonance angiography/ venography of the temporal bone, brain and internal auditory canal were performed if needed. Serum vitamin B₁₂ test is the most frequently used laboratory marker to measure the circulatory concentration of vitamin B₁₂. Blood samples were taken from all patients to analyse serum vitamin B₁₂ levels. Normal serum vitamin B₁₂ levels ranged from 187 to 883 pg/ml. Patients with serum vitamin B₁₂ levels lower than 187 pg/ml were supplemented with vitamin B₁₂ supplements. Patients were treated according to severity of vitamin B₁₂ deficiency.

Statistical analysis:

All collected data were entered in excel sheet and the data was statistically analysed by using SPSS software trial version 2022 (Statistic Package for Social Sciences). Descriptive statistical tests like proportion, percentage of categorical data, mean, standard deviation for quantitative data and inferential statistical tests like chi square test,

Spearman's rank correlation were performed to analyse the data. Significance level was considered at level $p < 0.05$.

III. Result

63 patients included in the study were in the age group from 19 to 72 years. Out of which, 38 were males and 25 were females. The mean age was 59 years. The mean age of male and female was 57 years and 61 years respectively. Patients had experienced tinnitus for duration 1 month to 10 years. The patients with normal vitamin B₁₂ had experienced tinnitus for average of 18.5 months and those with vitamin B₁₂ deficiency had experienced tinnitus for an average of 20.6 months.

Table no 3: Association nature of tinnitus and serum vitamin B₁₂ levels

Nature of tinnitus	Gender		Low serum vitamin B ₁₂ levels	Normal serum vitamin B ₁₂ levels
	Males	Females		
Intermittent- 72% (45)	25	20	60% (27)	40% (18)
Continuous – 28% (18)	15	3	77.8% (14)	22.2% (4)

Out of 63 patients, tinnitus was found to be unilateral in 54% of cases (right ear in 56% and left ear in 44% of these cases) and bilateral in 46% of cases.

Table no 4: Association of sound pattern in tinnitus and serum vitamin B₁₂ levels

Sound pattern in tinnitus	Low serum vitamin B ₁₂ levels	Normal serum vitamin B ₁₂ levels
Hissing – 58% (37)	26	11
Buzzing- 38.83% (24)	14	10
Swishing – 3.17% (2)	1	1

According to Tinnitus severity index, 36.5% were categorized as very mild, 26.98% as mild, 22.4% as moderate, 9.5% as severe and 4.62% as catastrophic. Out of this, 36.58% of very mild, 26.8% of mild, 22% of moderate, 9.75% of severe and 4.87% of catastrophic tinnitus severity had vitamin B₁₂ deficiency. The average score for TSI was 22.4. The mean tinnitus loudness measured by visual analogue scale was 6.38.

Out of 63 patients with idiopathic tinnitus, 64.3 % (41) had low vitamin B₁₂ levels and 35.7 % (22) had normal levels. The mean serum vitamin B₁₂ level was 211 ± 98 pg/ml, with maximum level was 679 pg/ml and minimum level was 80 pg/ml. No significant difference was observed between patients with vitamin B₁₂ deficiency and those with normal vitamin B₁₂ levels regarding age range ($p=0.35$). No statistically significant gender difference was observed among patients as regards to serum vitamin B₁₂ level ($p = 0.38$). Hearing loss was higher in ears with tinnitus. Hearing loss was not proportional to tinnitus severity.

Table no 5: Association of severity of hearing loss with serum vitamin B₁₂ levels

Severity of hearing loss	Low serum vitamin B ₁₂ levels	Normal serum vitamin B ₁₂ levels
Normal hearing sensitivity	68.4% (26)	31.6% (12)
Mild	56.3% (9)	43.7% (7)
Moderate	57.1% (4)	42.9% (3)
Severe	100% (2)	-

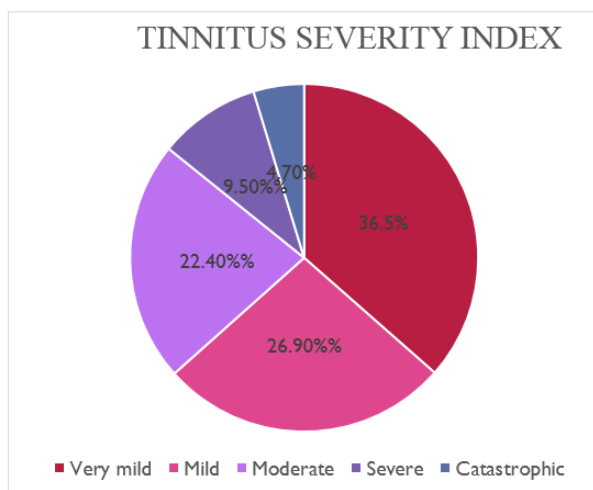


Figure no 1: Tinnitus severity scaling in idiopathic tinnitus patients

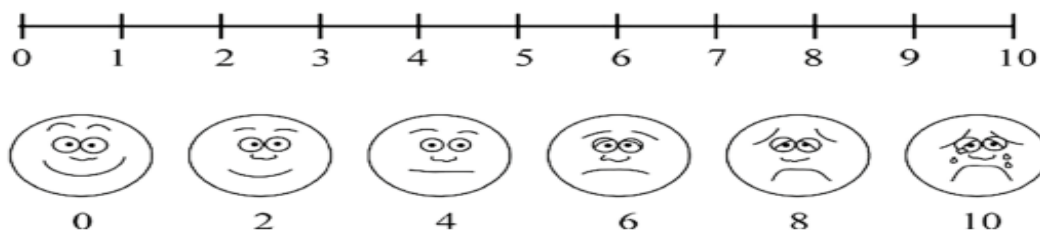


Figure no 2:

Visual analogue scale (VAS) scoring for tinnitus loudness

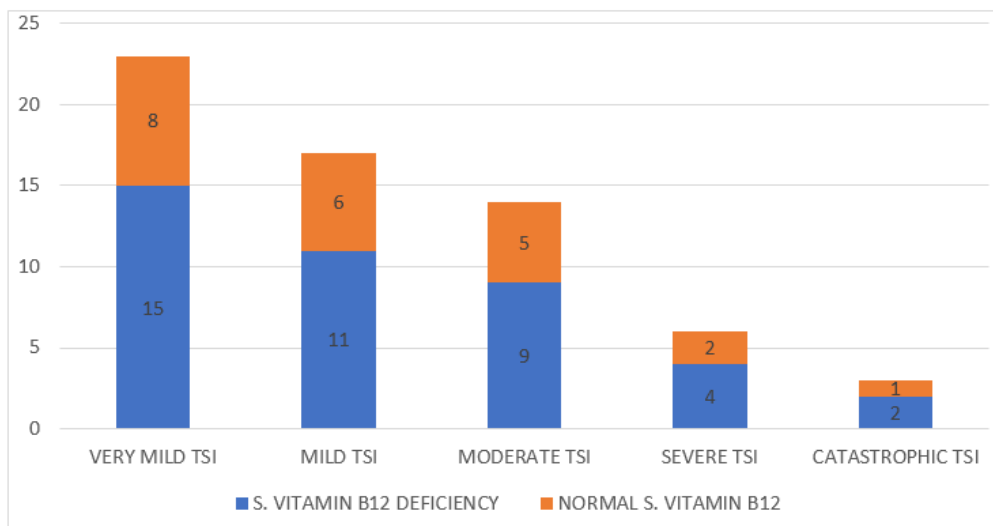
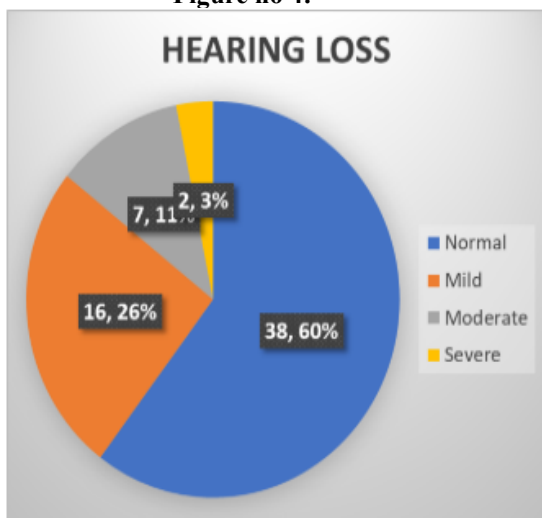


Figure no 3:

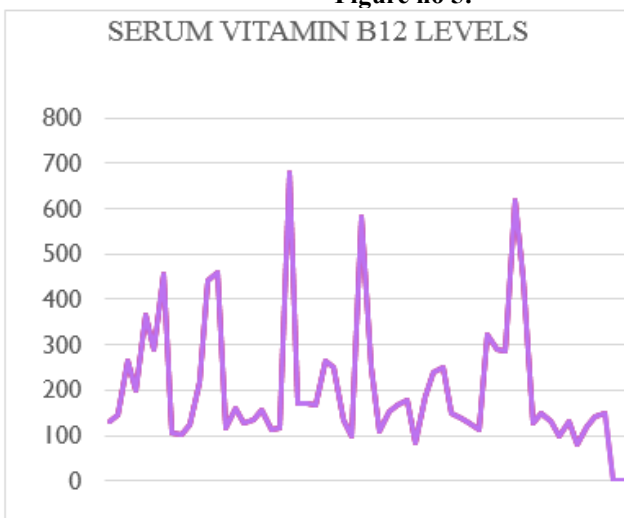
Association of serum vitamin B₁₂ levels in different tinnitus severity index categorized patient.

Figure no 4:



Hearing level of patients in pure tone audiometry

Figure no 5:



Serum vitamin B₁₂ levels in idiopathic tinnitus patients

IV. Discussion

Tinnitus is one of the common presenting ear complaints that can affect patient's quality of life. It has multifactorial causes. Although the cause is usually unknown, tinnitus can be due to auditory diseases, neurological disorders, psychiatric and metabolic disorders.⁽¹⁾

The treatment of tinnitus is highly variable. The mainstay of treatment depends upon the causative factors. The etiology of tinnitus includes aging, hearing loss, ototoxicity and environmental distress such as loud noise, trauma.⁽¹⁾ The common auditory secondary causes including external ear (cerumen impaction, otitis externa), middle ear (otosclerosis, otitis media, cholesteatoma), inner ear (vestibular schwannoma, meniere's disease, cochleitis).⁽¹⁾ The non auditory causes include vascular anomalies, myoclonus (stapedial myoclonus).⁽¹⁾ The mechanism of tinnitus has not been clearly explained. The most common classification of tinnitus is subjective and objective. Subjective tinnitus is the sound that can be only heard by the patient. Objective tinnitus is the sound that can also be heard by the examiner (identifiable source for acoustic stimulus, including joints, muscles, turbulent blood flow, rarely otoacoustic emissions).⁽¹⁾ Tinnitus severity index helps to assess the negative impacts of tinnitus on patient.⁽¹²⁾ Tinnitus severity index assess the psychological and emotional effects of tinnitus at a rate of 50%, effect on lifestyle at a rate of 37%, and effects specific to tinnitus at a rate of 17%.⁽¹²⁾

In Stouffer and Tyler study, tinnitus was present for more than 26 days per month in 74% of the patients. Tinnitus was bilateral in 52% of cases, unilateral in 37% of cases, localised in the cranium instead of ear in 10% of cases while in 1 % of cases as sound coming outside the head.⁽¹³⁾ In the present study, patients experienced tinnitus for duration of 1 month to 10 years. 54% of patients and 46 % of patients had unilateral and bilateral tinnitus respectively in the present study. Berkiten and Yildirim study reported tinnitus was bilateral in 43% and bilateral in 57% of cases.⁽¹⁴⁾

The impact of tinnitus on patient's life can be estimated subjectively by various questionnaires and visual analogue scale. Tinnitus severity index is a reliable method to assess the negative impacts of tinnitus on patient's life. In our study, all patients received questionnaire with 12 questions that help to assess the effect of tinnitus on daily activities and life. A study conducted by Berkiten and Yildirim performed audiometric tests between 250 and 20000 Hz. In that study tinnitus patients with vitamin B₁₂ deficiency showed improvement in hearing levels only at 250 Hz frequency after vitamin B₁₂ replacement.⁽¹⁴⁾ All our patients underwent pure tone audiometry for frequencies at octave intervals from 250 to 8000 Hz for both air and bone conduction. Out of 63 patients, 38 had normal hearing sensitivity while 25 had hearing loss. In nonrandomized study conducted in tinnitus patients at India in 2013, 60% of tinnitus ears had normal hearing on pure tone audiometry, 20% had mild hearing loss, 11.4% had moderate hearing loss and 8.6% had severe hearing loss.⁽¹⁵⁾

Tinnitus is considered to be due to anatomical or functional changes in the auditory system.⁽¹⁶⁾ Vitamin B₁₂ deficiency can cause reduction in blood flow to cochlea and result in hearing loss.⁽¹⁷⁾ Vitamin B₁₂ deficiency can affect myelination of cochlear nerve.⁽¹⁸⁾ In study conducted at Turkey in 2008, 63 patients with tinnitus had low serum vitamin B₁₂ while 37 had normal vitamin B₁₂ levels.⁽¹⁴⁾ The prospective study conducted at Nigeria in 2012 included healthy elderly with subjective tinnitus and those without. Plasma levels of melatonin, vitamin C and vitamin B₁₂ were compared among people with and without tinnitus. Vitamin B₁₂ levels were low among elderly with tinnitus compared to those without.⁽¹⁹⁾ Shemesh et al reported that vitamin B₁₂ deficiency in 47% of patients with tinnitus and hearing loss. The study also showed vitamin B₁₂ replacement treatment was useful in patients with chronic tinnitus.⁽²⁰⁾

V. Conclusion

Association of serum vitamin B₁₂ in patients with idiopathic tinnitus was significant in this study. More studies should be performed to assess if vitamin B₁₂ supplementation may be beneficial to tinnitus patients. Based on our study, there is enough evidence to recommend serum vitamin B₁₂ assessment in all tinnitus patients. Appropriate intervention improves the quality of life.

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