

Comparison of Vitamin B12 Levels in Patients of Tinnitus with High Frequency Hearing Loss and Low Frequency Hearing Loss

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ABSTRACT

Tinnitus, the perception of sound without an external stimulus, often coexists with hearing loss. As hearing loss increases, so does the incidence of tinnitus. Vitamin B12, a co-enzyme essential for cell growth and DNA synthesis, plays a crucial role in myelin protein synthesis. Deficiency in Vitamin B12 can lead to axonal degeneration, de-myelinization and neuronal death, affecting cochlear function and potentially causing hearing loss and tinnitus. This study aimed to explore the relationship between hearing loss, tinnitus and Vitamin B12 deficiency. To analyse Vitamin B12 levels in patients with tinnitus experiencing high frequency and low frequency hearing loss. This cross-sectional study was conducted over 18 months (January 2021 to July 2022) at the Department of ENT, Ramaiah Medical College Hospital, Bangalore. A total of 70 patients with tinnitus were enrolled after meeting inclusion and exclusion criteria. Patients with prior ear surgeries, objective tinnitus, radiotherapy, chemotherapy, ear trauma, psychiatric illness, or congenital otological issues were excluded. Pure Tone Audiometry (PTA) assessed hearing loss, categorized into high and low frequency. Serum Vitamin B12 levels were measured using Chemiluminescence immunoassay (CLIA). Patients were divided into two groups (35 each) based on PTA results. Vitamin B12 deficiency was defined as levels below 150 pg/mL. Descriptive statistics summarized Vitamin B12 levels and Chi square tests compared deficiencies across groups. A significant age-related difference was observed between high and low frequency hearing loss groups, indicating that hearing loss with tinnitus is more common in older adults. Additionally, tinnitus duration showed a significant difference between groups, with low frequency hearing loss more prevalent in those with tinnitus for one year or less. No significant differences in Vitamin B12 levels were found between age groups, genders, or tinnitus duration. Mean Serum Vitamin B12 was 407.95 ± 353.98 pg/mL in the high frequency group and 337.99 ± 343.16 pg/mL in the low frequency group, with no significant difference between the groups. High and low frequency hearing loss with tinnitus is more prevalent in older adults. A significant difference was noted in tinnitus duration, with low frequency hearing loss more common in shorter durations of tinnitus. However, no relationship was found between Serum Vitamin B12 levels and hearing loss or tinnitus.

INTRODUCTION

Tinnitus is a symptom in which sound is perceived even when there are no external stimuli. It can significantly and negatively affect quality of life if it is persistent and either unpleasant or sufficiently annoying to cause functional impairment in thought processing, emotions, hearing, sleep and concentration. As described by epidemiologic research, it affects between 8 and 25.3% of the US population, making it a widespread issue for millions of people. The prevalence of tinnitus has also been documented in population-based research carried out in various countries, ranging from 4.6-30%^[1].

Tinnitus was shown to have an incidence of 5.7% over a 5-year follow-up period and a prevalence of 8.2% in a population-based investigation of hearing loss in people aged 48 to 92 years. As people age, tinnitus is more common. Tinnitus is a subjective phenomenon that is challenging to assess scientifically because it can only be measured, defined and characterised by the replies of the people who experience it. Although, there are numerous potential origins of tinnitus, it typically arises from otologic problems, with noise-induced hearing loss being thought to be the most prevalent culprit^[2].

Tinnitus affects different groups of people differently, such as different age groups and the prevalence of tinnitus in women and men is also different. This means that a single number cannot describe the prevalence of tinnitus^[3]. It is therefore important to define the part of the population that is studied.

Tinnitus is also defined as perceiving sound in association with activity in the nervous system that does not match the resonant or mechanical activity in the cochlea. In many instances, hearing loss co exists with tinnitus. Furthermore, as hearing loss increases, so does the incidence of tinnitus^[4]. Vitamin B12 is a co-enzyme that has a role in particularly two important metabolic functions-in normal cell growth and DNA synthesis. Vitamin B12 is an important co-factor that plays a role in basic myelin protein synthesis. B12 deficiency is associated with axonal degeneration, de-myelination and subsequent neuronal death^[4]. Cochlear function is dependent on adequate vascular supply and the normal functioning of the nerve tissue. Lack of vitamin B12 may result in hearing loss by causing cochlear nerve neurons to de-myelinate. Furthermore, low vitamin B12 levels are linked to the degradation of the tria vascularis-microvasculature, which could lead to diminish endocochlear potential as well as hearing loss and tinnitus^[4].

MATERIAL AND METHODS

This prospective cross-sectional study was conducted on patients presenting with tinnitus to the

ENT Outpatient Department (OPD) at Ramaiah Medical College Hospital and Memorial Hospital, Bangalore, between January 2021 and July 2022.

Inclusion criteria: Patients aged 18 years and above presenting with tinnitus to the ENT OPD were included.

Exclusion criteria: Patients were excluded if they had previous ear surgeries, objective tinnitus, had received radiotherapy or chemotherapy, experienced trauma to the ear, had psychiatric illnesses, or had congenital anomalies contributing to otological problems.

Sample size: Based on the study by Berkiten *et al.*^[4], which observed that 63% of patients with tinnitus had low Vitamin B12 levels and anticipating similar results with high frequency hearing loss and 33% less in low frequency hearing loss, a minimum sample size of 70 subjects was determined. This included 35 subjects with high frequency hearing loss and 35 subjects with low frequency hearing loss, ensuring 80% power and a 95% confidence level.

Methods: Patients were informed and consent was taken for participation in the study. After a detailed medical/surgical history and clinical examination, patients who have suffered from previous ear surgeries, objective tinnitus, patients who have received radiotherapy and chemotherapy, trauma to the ear, psychiatric illness and congenital anomaly that contributed to otological problems were excluded. Pure tone audiometry was performed in all the 70 cases of tinnitus and serum vitamin B12 estimated in these 70 cases. Hearing was assessed by Pure Tone Audiometry (PTA) in terms of high frequency hearing loss and low frequency hearing loss. Subjects were deemed to be vitamin B12 deficient if the serum vitamin B12 levels were found to be below 150 pg/mL. The method used to estimate serum vitamin B12 levels was Chemiluminescence Immunoassay (CLIA). Patients were divided into 2 groups of 35 subjects each as low frequency and high frequency hearing loss according to the PTA report.

Statistical analysis: Data were entered into a Microsoft Excel data sheet and analyzed using SPSS version 22 software. Categorical data were displayed using frequencies and proportions. The Chi-square test or Fischer's exact test (for 2x2 tables) was used to determine the significance of qualitative data. Continuous data were represented as mean and standard deviation. An independent t-test was used to assess the mean difference between two quantitative variables, while ANOVA was used for more than two variables. Pearson correlation coefficient was used to perform correlations. Graphical representations of

data were created using MS Excel and MS Word. A $p < 0.05$ was considered statistically significant, following all statistical test assumptions.

Ethical clearance: The study received ethical approval from the institution's ethical committee prior to its initiation.

RESULTS

The age distribution of patients with high frequency hearing loss and low frequency hearing loss shows a statistically significant difference ($p = 0.027$). Among those with high frequency hearing loss, 8.6% were under 30 years, 14.3% were between 31-50 years, 62.9% were between 51-70 years and 14.3% were over 70 years. For patients with low frequency hearing loss, 31.4% were under 30 years, 25.7% were between 31-50 years, 34.3% were between 51-70 years and 8.6% were over 70 years. The gender distribution did not show a statistically significant difference between the two groups ($p = 0.473$). In the high frequency hearing loss group, 45.7% were female and 54.3% were male. In the low frequency hearing loss group, 57.1% were female and 42.9% were male. The duration of tinnitus showed a statistically significant difference between the groups ($p = 0.031$). In the high frequency hearing loss group, 37.1% of patients had tinnitus for less than 1 year, 51.4% had tinnitus for 1-5 years and 11.4% had tinnitus for more than 5 years. In the low frequency hearing loss group, 68.6% had tinnitus for less than 1 year, 25.7% had tinnitus for 1-5 years and 5.7% had tinnitus for more than 5 years (Table 1).

Independent t-test: Mean Serum Vitamin B12 among subjects with High frequency Hearing Loss was 407.95 ± 353.98 pg/mL and Mean Serum Vitamin B12 among subjects with Low frequency Hearing Loss was 337.99 ± 343.16 pg/mL. There was no significant difference in Vitamin B12 levels between two groups (Table 2).

#ANOVA test, independent t-test: The mean Vitamin B12 levels for patients under 30 years were

230.1643 ± 170.0391 pg/mL, for those aged 31-50 years it was 238.392 ± 79.950 pg/mL, for patients aged 51-70 years it was 468.282 ± 445.371 pg/mL and for those over 70 years it was 453.350 ± 252.303 pg/mL. The difference in Vitamin B12 levels across these age groups approached statistical significance ($p = 0.056$). The mean Vitamin B12 levels were 396.336 ± 367.131 pg/mL for females and 348.238 ± 329.920 pg/mL for males. This difference was not statistically significant ($p = 0.567$). The mean Vitamin B12 levels for patients with tinnitus duration of less than 1 year were 322.894 ± 207.591 pg/mL, for those with a duration of 1-5 years it was 432.107 ± 490.330 pg/mL and for patients with tinnitus for more than 5 years it was 415.700 ± 264.328 pg/mL. There was no statistically significant difference in Vitamin B12 levels based on the duration of tinnitus ($p = 0.447$) (Table 3).

Age and had a significant positive correlation with serum Vitamin B12 ($r = 0.229$, $p = 0.012^*$). I.e., with increase in Age there was increase in Vitamin B12 levels and vice versa (Fig. 1).

DISCUSSION

The present study aimed to investigate the relationship between Vitamin B12 levels, age, gender, duration of tinnitus and hearing loss frequencies among patients with high and low frequency hearing loss. The findings reveal significant insights into these associations.

The age distribution of patients with high frequency and low frequency hearing loss showed a statistically significant difference ($p = 0.027$). Patients with high frequency hearing loss were predominantly older, with 62.9% aged between 51-70 years. This is consistent with the literature indicating that high frequency hearing loss is more common in older adults due to age-related auditory degeneration (Presbycusis)^[5,6]. This finding is supported by Cruickshanks *et al.*^[7], who found a similar age-related prevalence of hearing loss in older adults in Beaver Dam, Wisconsin.

The gender distribution did not show a statistically significant difference between the two groups ($p = 0.473$). In our study, both high and low

Table 1: Profile of subject's comparison between two groups

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	High frequency hearing loss		Low frequency hearing loss		p-value
	No.	Percent	No.	Percent	
Age group					
<30 years	3	8.6	11	31.4	0.027*
31-50 years	5	14.3	9	25.7	
51-70 years	22	62.9	12	34.3	
>70 years	5	14.3	3	8.6	
Sex					
Female	16	45.7	20	57.1	0.473
Male	19	54.3	15	42.9	
Duration of tinnitus					
<1 years	13	37.1	24	68.6	0.031*
1-5 years	18	51.4	9	25.7	
>5 years	4	11.4	2	5.7	
Chi-square test					

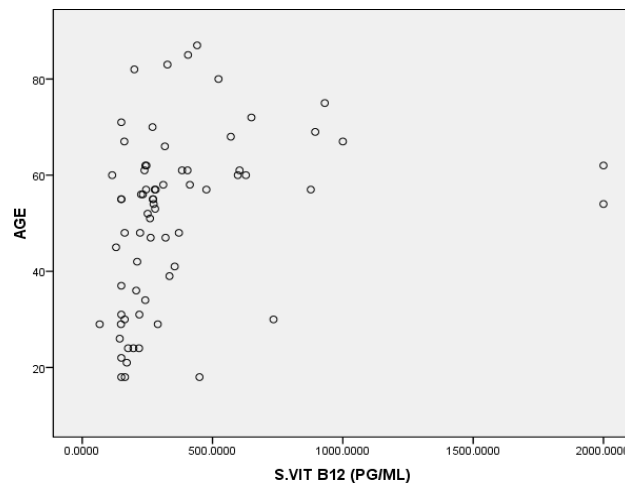


Fig. 1: Scatter plot showing positive correlation of age with serum vitamin B12

Table 2: Vitamin B12 levels comparison between two groups

	Mean	SD	p-value
High frequency hearing loss	407.95	353.98	0.404
Low frequency hearing loss	337.99	343.16	

Table 3: Comparison of vitamin B12 with respect to age, gender and duration of tinnitus

	Mean	SD	p-value
Age			
<30 years	230.1643	170.0391	0.056 [#]
31-50 years	238.3920	79.9500	
51-70 years	468.2820	445.3710	
>70 years	453.3500	252.3030	
Gender			
Female	396.3360	367.1310	0.567
Male	348.2380	329.9200	
Duration of tinnitus			
<1 years	322.8940	207.5910	0.447 [#]
1-5 years	432.1070	490.3300	
>5 years	415.7000	264.3280	

frequency hearing loss affected males and females similarly. This aligns with findings from Nelson *et al.*^[8] that occupational noise exposure is a significant factor for hearing loss across genders. However, our results contrast with some studies that suggest a higher prevalence of high frequency hearing loss in males due to occupational and environmental noise exposure^[9,10].

The duration of tinnitus showed a statistically significant difference between the groups ($p = 0.031$). Patients with high frequency hearing loss experienced tinnitus for longer durations compared to those with low frequency hearing loss. This finding may be attributed to the chronic nature of high frequency hearing loss and its associated prolonged tinnitus symptoms^[11].

Comparing serum Vitamin B12 levels between the two groups revealed no significant difference ($p = 0.404$). The mean serum Vitamin B12 level was higher in the high frequency hearing loss group (407.95 ± 353.98 pg/mL) compared to the low frequency hearing loss group (337.99 ± 343.16 pg/mL). Previous studies, such as Houston *et al.*^[12], have suggested a potential link between low Vitamin B12 levels and hearing loss, particularly in the elderly. However, our

findings did not show a clear association, which might be due to the small sample size or other uncontrolled confounding factors.

When analysing Vitamin B12 levels with respect to age, the levels approached statistical significance ($p = 0.056$), indicating a trend towards higher Vitamin B12 levels in older patients. This could be due to increased health awareness and dietary supplementation in older adults. This trend is in line with findings from Morris *et al.*^[13], who reported increased Vitamin B12 supplementation in older populations. The gender-based comparison of Vitamin B12 levels showed no significant difference ($p = 0.567$), consistent with studies that report no substantial gender differences in Vitamin B12 levels in the general population^[14].

The duration of tinnitus did not significantly impact Vitamin B12 levels ($p = 0.447$). This suggests that the duration of tinnitus does not influence Vitamin B12 status, although some studies have proposed a potential link between prolonged tinnitus and nutritional deficiencies^[15].

The scatter plot analysis demonstrated a significant positive correlation between age and serum Vitamin B12 levels ($r = 0.229$, $p = 0.012$). This finding suggests that as age increases, Vitamin B12 levels also tend to increase, possibly due to increased supplementation or dietary intake among older adults^[16].

CONCLUSION

From the study it can be concluded that there was statistically significant difference in the age distribution between patients with high frequency and low frequency hearing loss, indicating that high frequency hearing loss was more prevalent in older age groups. Gender distribution did not differ significantly between the groups. However, the duration of tinnitus showed a significant difference, with high frequency hearing

loss patients experiencing longer durations of tinnitus. Although mean serum Vitamin B12 levels were higher in the high frequency hearing loss group compared to the low frequency hearing loss group, this difference was not statistically significant. When comparing Vitamin B12 levels with respect to age, the levels approached statistical significance, suggesting a potential trend of higher Vitamin B12 levels in older patients. Gender and duration of tinnitus did not show significant differences in Vitamin B12 levels. Furthermore, a positive correlation was observed between age and serum Vitamin B12 levels, indicating that Vitamin B12 levels tend to increase with age.

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