

Vitamin D Level and its Relation to Tinnitus

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**Original
Article**

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ABSTRACT

Objective: To evaluate vitamin D levels in patients with tinnitus and to assess subjectively the efficacy of its supplementation in case of deficiency.

Patients and Methods: 35 adult complaint of bilateral tinnitus with the age range from 20 to 50 years were included. All had bilateral normal audiological evaluation. Vitamin D level was assessed and those that had deficiency received supplementation for 3 months. Tinnitus handicap inventory (THI) was taken for the first time to all participants and another time for those received vitamin D supplementation after the 3 months regiment, and comparing the results.

Results: From the 35 participants there was 30 subjects had vitamin D deficiency (85.71 %). THI before treatment showed larger numbers in scale 3 then 2, 1, 4 with no patients with scale 5. while THI after treatment showed larger numbers in scale 1 then 2 & 3 with no patients with scale 4 & 5. There was no significant correlation between THI score & Vitamin D level and the age of the participant or the duration of the complaint.

Conclusion: Vitamin D deficiency is common among tinnitus patients. The result of vitamin D supplementation is promising in cases of idiopathic tinnitus. We recommend doing vitamin D assay in patients with idiopathic tinnitus and hence giving vitamin D supplementation in case of deficiency trying to improve the quality of life.

Key Words: Tinnitus, tinnitus handicapped inventory, vitamin D.

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INTRODUCTION

Tinnitus is the perception of a sound in the absence of an external stimulus. This perception of the sound is associated with activity in the nervous system that does not match the resonant or mechanical activity in the cochlea. Tinnitus may be unilateral or bilateral and can be perceived as coming from within or outside the head^[1]. There is variable prevalence of tinnitus that is ranged from 232%-, its prevalence increases with advancing age and it is more common in men than in women^[2]. The character of tinnitus perception can vary, with ringing, clicking, buzzing and pulsations. There are variable effects of tinnitus on the quality of life such as depression, anxiety and extreme life changes^[3]. Risk factors for tinnitus are variables. Hearing loss is the main risk factor even though there are patients that present with tinnitus and normal hearing threshold^[4]. Thus, an unknown pathogenesis in addition to a heterogeneity in the presentations, lead to a difficulty in the management of tinnitus. The role of diet in tinnitus control had been identified as a research priority by both patients and clinicians^[5]. There is evidence for certain foods, nutrients, and dietary supplements exacerbating or reducing tinnitus; however, there is little research evidence for a role of any particular dietary factor in contributing to

tinnitus^[6,7&8]. Limited research in relation to vitamin D and the effects of supplementation and tinnitus is inconsistent.

The rationale of our study is to understand the connection between vitamin D deficiency and tinnitus.

OBJECTIVES:

The objective of this study was the evaluation of vitamin D levels in patients with tinnitus and subjective assessment of the efficacy of vitamin D supplementation in patients complaining of tinnitus and associated vitamin D deficiency.

PATIENTS AND METHODS:

This study was conducted in the Audiology Unit, Otolaryngology department, East Jeddah Hospital from December 2018 to November 2019.

2.1. Participants:

The study was done on 35 adult with the following inclusion criteria: clinical complaint of bilateral tinnitus for more than one year, with the age range from 20

to 50 years, free otoscopic examination, no complaint of diminution of hearing, no history of hearing loss, exposure to noise, ototoxic drugs or ear operation. Exclusion criteria includes, unilateral tinnitus, objective tinnitus or systemic causes of tinnitus such as: anaemia, hypertension, diabetes, cardiac disorders or endocrine problems.

2.2. Research ethics

Written informed consent was granted by all the participants after clarification of the explanations for conducting the study. Moral approval for conducting the study was granted by the committee. The work was administered in accordance with the code of Ethics of the globe Medical Association (Declaration of Helsinki) for experiments involving humans.

2.3. Methodology:

A) Audiological evaluation:

a- **Detailed history:** The participants were asked about medical history: hypertension, Diabetes, heart disease, endocrine disorders.

b- Otoloscopic examination:

a- **The audiometric evaluation:** was carried out inside a sound treated room AC 40 Audiometry cabin calibrated to ISO 9001 standards. It includes -Pure tone audiometry (PTA) using an audiometer (Interacoustics AD629). PTA includes air and bone conduction. -Speech audiometry Includes: -Speech Reception Threshold (S.R.T): using Bisyllabic words for adult and -word Speech Discrimination (S.D): using Arabic Phonetically balanced words.

a- **Immitencemetry:** (Interacoustics AT235) including tympanometry and acoustic reflex threshold.

B) Questionnaire:

Tinnitus Handicap Inventory (THI) questionnaire is a scale that measures the discomfort caused by tinnitus, with questions related to every day annoyances and losses attributed to the symptom, The final score is calculated by degree from 1 (slight, only perceived in quiet environments) to 5 (catastrophic).

C) Vitamin D:

a- **Vitamin D level in the serum:** Blood samples were taken after overnight fasting, with analysis of vitamin D level in serum. Subjects were considered to have vitamin D deficiency if the serum level was less than 30 ng/ml. Then all subjects with normal vitamin D level were excluded from the study.

b- **Vitamin D supplementation:** all the participants with vitamin D deficiency were receiving vitamin D oral capsule 50000 IU/ week regularly for 3 months.

D) Re-evaluation:

All participants with tinnitus and vitamin D deficiency were re-evaluated after the full regimen of vitamin D supplementation by subjective perception of tinnitus, THI and vitamin D assay in the serum.

2.4. Statistical analysis:

Data was analyzed using IBM SPSS Statistics for Windows version 23.0. The statistical tests used in the analysis included paired t-test, Pear-son’s chi-squared test, and correlation co-efficient measures. In all conclusions reached through the inferential analysis, the significance level = 5% was used.

RESULTS:

35 adult complained of bilateral tinnitus were included in this study with an age range from 20 to 50 years with a mean of 35.17 years and the standard deviation was 8.28. As regards gender distribution they were 22 females (62.86 %) and 13 males (37.14 %). The average duration of tinnitus complaint was 2.8 years.

All participants had bilateral normal hearing sensitivity in PTA with average of 18.2 dB with bilateral excellent word discrimination scores. All participants showed bilateral type (A) tympanograms with bilateral intact ipsilateral and contralateral acoustic reflexes.

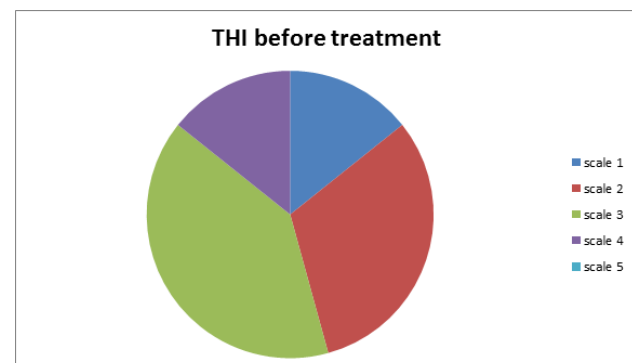


Fig. (a): THI before treatment showed larger numbers in scale 3 then 2, 1, 4 with no patients with scale 5.

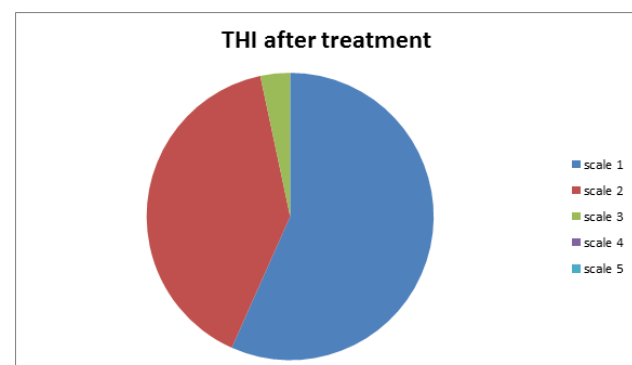


Fig. (b): THI after treatment showed larger numbers in scale 1 then 2 & 3 with no patients with scale 4 & 5.

From the 35 participants there was 30 subjects had vitamin D deficiency (85.71 %). There was no statistically significant difference observed between male and female patients as regards vitamin D level ($p = 0.38$, chi-square = 1.9).

After vitamin D supplementation all the thirty patients showed improvement in vitamin D level while twenty-five out of the thirty showed improvement in THI.

Table 1: Paired t test for vitamin D level & THI before and after treatment:

	Before treatment		After treatment		P
	Mean	SD	Mean	SD	
Vitamin D level	14.13	5.95	51.07	49.46	0.056
THI	2.50	0.88	1.47	0.57	0.00002

There was a statistically significant difference in vitamin D level & THI before and after treatment.

Table 2: Correlation test of THI & Vitamin D level with the age of the patients and the duration of tinnitus.

Correlation Coefficient	THI before treatment		THI after treatment		Vitamin D before		Vitamin D after	
	R	P	R	P	R	P	R	P
Age	0.108	.569	0.034	.858	-0.096	0.614	-0.230	0.221
Duration	0.02	.904	-0.017	.929	0.293	0.088	-0.035	0.854

There was no significant correlation between THI score & Vitamin D level and the age of the participant or the duration of the complaint.

DISCUSSION

Tinnitus is a common problem that can affect the patient's quality of life. Since tinnitus mostly is a symptom of a problem, the first thing in management plan is determining the underlying cause, in addition to checking the hearing status and other medical problems. The most effective treatment is to work on the underlying cause. However, if the underlying cause is not identifiable in this case tinnitus itself needs to be managed.

As regards the gender distribution in the current study the female patients was more than males 62.86 % versus 37.14 % respectively. This was similar to other studies that showed the higher incidence of tinnitus among females^[9 & 10]. In the contrary Demeester *et al* reported that tinnitus is more common in males than in females^[11]. Tinnitus is often bilateral, in our study all participant was selected complaint of bilateral tinnitus. Stouffer and Tyler reported that tinnitus was bilateral in 52% of cases^[12].

In the current study the THI before vitamin D supplementation showed that the larger numbers of the patients had moderate degree of impairment, followed by mild, slight then severe degrees and no patients had catastrophic degree (Figure. a). However, the condition changed after treatment with vitamin D as twenty-five out of the thirty (83.33 %) showed improvement in THI. (Figure b) showed that larger number of patients improved to slight degree and no patient had severe

or catastrophic degrees. This means that vitamin D supplementation can improve tinnitus perception and the patient quality of life in those participants.

There is more than one explanation that vitamin D deficiency can influence the auditory system and can lead to perception of tinnitus. The first explanation was that the deficiency of the Vitamin D leads to impairment in the calcium metabolism and microcirculation in the cochlea^[13]. The second one is that vitamin D deficiency may lead to affection of the bone mineralization of the ossicles. The body has a typical compensation in relation to Vitamin D levels. When the reserves of Vitamin D are low, the calcium gets decreased too as a result of failure of vitamin D reabsorption of calcium from the kidney and intestine. The decreased calcium level activates the osteoclasts and up regulates bone resorption first from dense bones then from small bones^[14 & 15]. The woven bone of the otic capsule has higher contents of Calcium and Phosphorus than other bones in the body and hence may be more affected by vitamin D deficiency and Calcium levels^[16]. So vitamin D deficiency can lead to demineralization of cochlea

The third explanation is that the role of vitamin D in the defense mechanisms of the body. Common cold, pharyngitis and acute otitis media occurred by many pathogens which are bacteria or viruses and many of these pathogens are sensitive to antimicrobials,

cathelicidin and Defense in that are released by the body under the influence of vitamin D^[17 & 18]. The epithelium that faces directly the environment like the skin and the respiratory mucosa are protected by innate immunity^[19]. Vitamin D has a major role in this type of immunity as Toll like Receptor and Vitamin D receptor are present on the macrophages that control the innate immunity^[20 & 21]. Vitamin D also regulates the level of the CYP27B1 enzyme that is responsible for the secretion of the major antimicrobial Cathelicidin^[22]. Vitamin D also acts as a chemotractant for monocytes and Neutrophils^[23 & 24]. Therefore vitamin D deficiency definitely causes impaired immunity with the resulting increase of the incidence of upper respiratory tract infection that leading to Eustachian tube dysfunction with affection on the auditory function^[25].

There was no significant correlation between THI score & Vitamin D and the age of the participant (Table 2). This means that the score of THI and the level of vitamin D not related to the age of the patient or duration of the complaint.

CONCLUSION

The incidence of vitamin D deficiency is common among tinnitus patients. The result of vitamin D supplementation is promising in those individuals. We recommend doing vitamin D assay in patients with idiopathic tinnitus and hence giving vitamin D supplementation in case of deficiency trying to decrease the subjective perception of tinnitus and the improving the quality of life.

CONFLICT OF INTEREST

There are no conflicts of interest.

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