

## A cross-sectional Analysis of the Relationship between Tinnitus Functional Index and Anxiety and Depression Disorders in Tinnitus Patients with Normal Hearing

Heba Ghannoum <sup>1</sup>\*MD; Reham Rafei El Shafei <sup>2</sup>MD and Eman Mostafa Basiouny <sup>3</sup>MD.

### \*Corresponding Author:

Heba Ghannoum

[Heba.ghannoum@med.helwan.edu.eg](mailto:Heba.ghannoum@med.helwan.edu.eg)

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<sup>1</sup>Audio-vestibular medicine, Otolaryngology Department, Faculty of Medicine, Helwan University, Cairo , Egypt.

<sup>2</sup>Audio-vestibular medicine, Otolaryngology Department, Faculty of Medicine, Fayoum University, Cairo , Egypt.

<sup>3</sup>Audio-vestibular medicine, Otolaryngology Department, Faculty of Medicine, Bani Suef University, Cairo , Egypt.

### ABSTRACT

**Background:** There is a substantial prevalence of psychopathology of anxiety or depression, and several mental problems in many tinnitus groups.

**Aim of The Work:** To use the Tinnitus Functional Index (TFI) as a valid scale for assessing the overall severity of tinnitus and detailed analysis of multiple severity domains, and correlating it to The Hospital Anxiety and Depression Scale (HADS) scores , This to establish a potential correlation between tinnitus and anxiety and depressive disorders to improve tinnitus clinical implications and rehabilitation.

**Subjects and Methods:** A cross-sectional study design was designed to explore the prevalence of psychological disorders among patients with tinnitus and to analyse its multiple severity domains thresholds using both TFI & HADS questionnaires.

**Results:** There was a positive correlation between both anxiety & depression subscales of (HADS) and total TFI scores with its subscales.

**Conclusion:** Despite the limited understanding of psychological concerns in tinnitus patients, the prevalence of anxiety disorders in these populations has increased. The reported co-occurrence might impact the clinical course of tinnitus and its management.

**Keywords:** Tinnitus Functional Index; Anxiety; Depression; Questionnaires.

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### INTRODUCTION

Tinnitus is the conscious perception of sound in the absence of external stimulation. This sound could be sizzling, raining, whistling, or hissing. It varies from one person to another.<sup>1</sup> It is estimated that the prevalence of tinnitus in the general adult population ranges between 10 and 15 %<sup>2,3</sup>.

Tinnitus can be a result of physiological or pathological causes, or due to the use of certain medications, or due to noise exposure. Besides, studies have shown that some disorders, such as stress, depression, and anxiety, can cause or exacerbate tinnitus. It is believed that 26% of tinnitus sufferers also experience anxiety<sup>4</sup>. Anxiety is characterized by apprehension, unease, or fear of the unexpected or unknown.<sup>5</sup> Anxiety, usually generates both emotional and physical responses in

the body and could also increase a person's overall stress levels.

There is a substantial association between severe tinnitus and symptoms of depression and anxiety, according to many authors<sup>5</sup>. Theoretically, these symptoms may also precede the onset of tinnitus and predispose to its development; in other words, they may represent non-auditory symptoms generated by the same pathophysiological abnormalities as tinnitus<sup>6</sup>. However, correlation does not necessarily suggest causation from an epidemiological perspective.

Tinnitus Functional Index (TFI) is a novel questionnaire that has shown validity for both scaling the severity and negative impact of tinnitus. It can be used as self-analysis and would provide an extensive overview of various tinnitus severity disciplines. Additionally, for measuring treatment-related improvements.<sup>7</sup>

The Hospital Anxiety and Depression Scale (HADS) was developed in 1983 by Zigmond and Snaith<sup>8</sup> to evaluate the degree of depression and anxiety among patients in nonpsychiatric clinics. Two distinct HADS subscales were devised to measure anxiety and depression.

The purpose of this study was to use the TFI as a valid scale for assessing the overall severity of tinnitus and detailed analysis of multiple severity domains, and correlating it to the HADS scores in order to establish a potential correlation between tinnitus and anxiety and depressive disorders in order to improve tinnitus clinical implications and rehabilitation.

### SUBJECTS AND METHODS

A cross-sectional study design was designed to explore the prevalence of anxiety and depressive disorders among patients with tinnitus and normal hearing thresholds. This study covered (50) tinnitus patients. The study group underwent essential audiological and filled in the Arabic versions of both questionnaires TFI & HADS<sup>9</sup>. This study was conducted for one year, from July 2021 to July 2022. Data collection was done at a multi-central level collaterally at the audio-vestibular medicine outpatient clinic of three university hospitals: Fayoum, Beni Suef and Helwan.

This study included tinnitus patients ageing between 20 -70 years from both genders. A patient with any

degree of hearing loss or noise dips or any patient with a known psychological disorder was excluded from this study.

All subjects underwent a full medical history including a complete description of the tinnitus character, frequency, and duration. This was followed by Full Basic audiological assessment including Pure tone audiometry: air conduction thresholds at frequencies between 250-8000Hz, bone conduction thresholds and speech audiometry: Speech reception threshold (SRT)<sup>10</sup> and word discrimination scores (WDS)<sup>11</sup>, acoustic immittance testing including tympanometry and acoustic reflexes both (ipsilateral and contralateral). Then those patients were administered two questionnaires: The Arabic version of the Hospital Anxiety and Depression Scale (HADS) 6 (Appendix1) and The Arabic version of the Tinnitus Functional Index (TFI).

### Statistical plan

Data was analysed using IBM® SPSS® v.28. Qualitative data was presented as frequency and percent, while quantitative data was presented as mean ± SD or median (and IQR) according to result of normality test. Independent t-test and Pearson's correlation were used for normally-distributed data while independent Mann-Whitney U test and Spearman's correlation were used for not-normally distributed data.

### RESULTS

The study comprised 50 patients. Table 1: showed their general characteristics. Age of the study participants ranged from 15 to 70 year-old, with mean ± SD = 34.12 (±11.15). Of the study participants 52% and 48% are females and males, respectively. Table 2 demonstrated the descriptive Statistics for the duration of tinnitus (24.2 months) and the total scores of HADS (19.1), Tinnitus functional Index (58.5), and their subscales. Comparing scores of different scales and gender in Table 3 , no significant statistical difference was found among males and females and neither TFI scores nor HADS scores.

Table 4 showed the correlation between the anxiety subscale of (HADS) and TFI with its subscales. There was a significant weak association between anxiety and each of "TFI, cognitive, auditory, and emotional subscales". However, there was a significant moderate association between anxiety and each of "intrusive and QOL subscales. Further Correlation between the depression subscale of (HADS) and TFI with its subscales in Table 5 showed that there is a significant weak association between depression and sense of control subscale. However, there was a significant moderate association between depression and each of "TFI, intrusive, cognitive, sleep, QOL, and emotional subscales.

Another correlation was done in Table 4 between overall TFI and each of duration of tinnitus and HADS with its anxiety and depression subscales. There was a significant weak association between TFI and each of duration of tinnitus in months and the anxiety subscale of HADS. While, there is a significant moderate association between TFI score and both of depression subscale and total "HADS" scores.

The mean scores of TFI and median scores of HADS in relation to the duration of tinnitus plotted on figure 1 and in relation to age group was shown in Figure 2.

Tables and figures

<b>Gender: Frequency (%)</b>	<b>Female</b>	<b>26 (52)</b>
	<b>Male</b>	<b>24 (48)</b>
<b>Age: Mean (± SD) years</b>	<b>34.12 (±11.15)</b>	

**Table 1:** General characteristics of study participants (n=50)

	<b>mean (±SD)</b>	<b>median (IQR)</b>
<b>Duration in months</b>	24.2 (28.7)	12 (8-24)
<b>Anxiety</b>	9.72 (4.1)	10 (7-13)
<b>Depression</b>	9.38 (3.7)	9 (7-11.25)

<b>HADS score</b>	19.1 (6.7)	18.5 (16-23)
<b>Intrusive</b>	64.99 (24.1)	66.6 (49.15-84.13)
<b>Sense of control</b>	60.7 (21.8)	66.6 (40-80)
<b>Cognitive</b>	56.17 (23.9)	60 (39.15-73.3)
<b>Sleep</b>	55.9 (25.7)	60 (36.6-77.45)
<b>Auditory</b>	49.1 (25.1)	46.6 (33.3-64.98)
<b>Relaxation</b>	63.8 (23.98)	66.6 (50-84.13)
<b>QOL</b>	53.82 (22.3)	57.5 (35-71)
<b>Emotional</b>	69 (23.1)	74.95 (50-87.45)
<b>TFI</b>	58.5 (16.9)	64.28 (45-70.7)

**Table 2:** Descriptive Statistics for duration in months and scores of HADS, Tinnitus functional Index, and their subscales.

	<b>Female n= 26</b>	<b>Male n= 24</b>	<b>p-value</b>
<b>HADS score: mean (<math>\pm</math>SD)</b>	19.5 ( $\pm$ 6)	18.7 ( $\pm$ 7.5)	0.665
<b>Overall TFI score: median (IQR)</b>	65.2 (21.7)	62.2 (28.27)	0.497

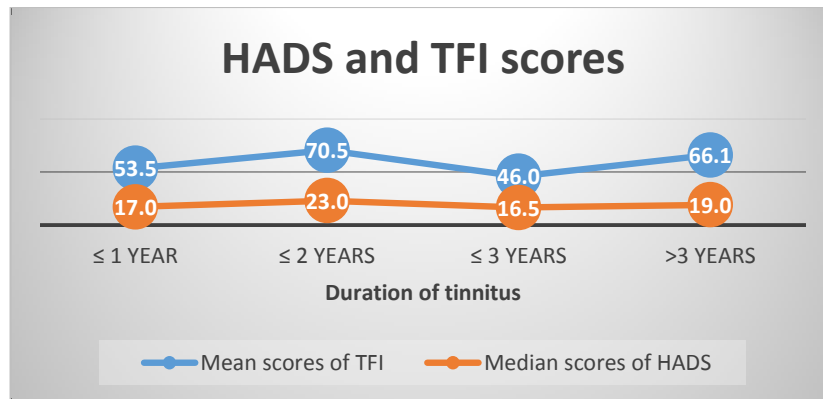
**Table 3:** HADS and TFI scores for males and females.

	<b>Correlation coefficient</b>	<b>p-value</b>
<b>Intrusive subscale</b>	<b>0.420</b>	<b>0.002</b>
<b>Sense of control subscale</b>	-0.01*	0.947
<b>Cognitive subscale</b>	<b>0.358*</b>	<b>0.011</b>
<b>Sleep subscale</b>	0.193	0.179
<b>Auditory subscale</b>	<b>0.291</b>	<b>0.040</b>
<b>Relaxation subscale</b>	0.214	0.136
<b>QOL subscale</b>	<b>0.421*</b>	<b>0.002</b>
<b>Emotional subscale</b>	<b>0.340*</b>	<b>0.016</b>
<b>Overall TFI</b>	<b>0.339*</b>	<b>0.016</b>

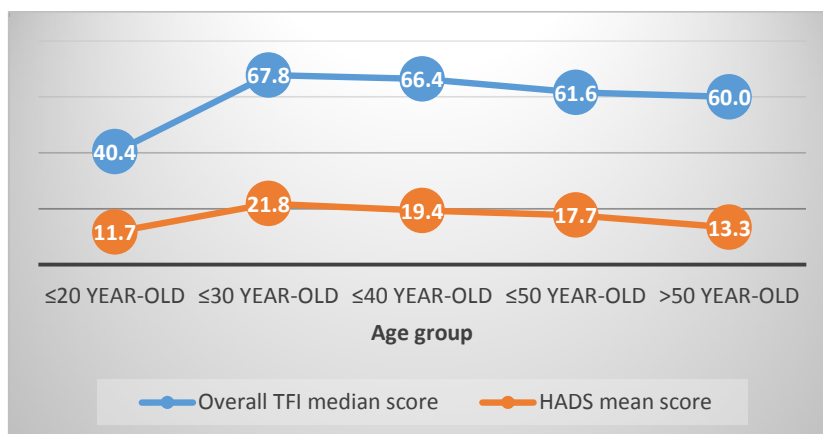
**Table 4:** Correlation between the anxiety subscale of Hospital anxiety and depression scale (HADS) and TFI with its subscales

	<b>Correlation coefficient</b>	<b>p-value</b>
<b>Intrusive subscale</b>	<b>0.415</b>	<b>0.003</b>
<b>Sense of control subscale</b>	<b>0.357*</b>	<b>0.011</b>
<b>Cognitive subscale</b>	<b>0.506*</b>	<b>&lt;0.001</b>
<b>Sleep subscale</b>	<b>0.430</b>	<b>0.002</b>
<b>Auditory subscale</b>	0.279	0.05
<b>Relaxation subscale</b>	0.135	0.35
<b>QOL subscale</b>	<b>0.487*</b>	<b>&lt;0.001</b>
<b>Emotional subscale</b>	<b>0.431*</b>	<b>0.002</b>
<b>Overall TFI</b>	<b>0.539*</b>	<b>&lt;0.001</b>

**Table 5:** Correlation between the depression subscale of Hospital anxiety and depression scale (HADS) and TFI with its subscales



**Fig. 1:** Line graph showing mean scores of TFI and median scores of HADS according to duration of tinnitus.



**Fig. 2:** Line graph showing mean scores of TFI and median scores of HADS according to age group.

## DISCUSSION

There is a substantial prevalence of psychopathology of anxiety or depression, and several mental problems in many tinnitus groups. Using Structured Clinical Interviewing methods, many authors<sup>11,12</sup> investigated the lifelong comorbidity of mental disorders to identify psychopathology and indicated a lifetime incidence of 45% for anxiety disorders.

TFI is mainly used to identify the functional impact on tinnitus patients and also to evaluate how tinnitus affects a patient's life and hence the necessity for intervention is determined.

Consequently, depending on the score of TFI, the patients' degree of affection was categorized as follows: mild tinnitus indicating little or no need for intervention, moderate tinnitus indicating a possible need for intervention and lastly significant tinnitus which necessitates aggressive intervention<sup>7</sup>.

While some individuals with tinnitus appear to be able to live well with the problem, others report being emotionally affected by it<sup>13</sup> with 1.6% of the population suffering anxiety and distress and 0.5% feeling so badly disabled that they cannot maintain a normal lifestyle<sup>14</sup>. Similarly, in the current study a weak positive correlation between both anxiety & depression and sense of control subscale was found. More and above, there is a strong positive correlation between depression and each of "TFI, intrusive, cognitive, sleep, QOL, and emotional subscales.

Moreover, a potential correlation between tinnitus and anxiety and depression in adults and the elderly of both sexes has been discovered, as well as the effect of aging on the severity of tinnitus and accompanying mental health difficulties, which impact the quality of life of these individuals.<sup>15</sup> The high prevalence of depression and anxiety among tinnitus patients in this study came in accordance with several other studies<sup>16,4,15</sup>. However, during this study no significant increase in both HADS scores & TFI scores has been shown related to age; this may be attributed to the relatively small sample of this age group and the need of larger study groups of different age categories. The auditory cortex is the central key in tinnitus but not anxiety disorders. Changes in GABAergic, glycinergic, and glutamatergic neurotransmission mediate central auditory circuit activity<sup>17</sup>. GABA, the primary inhibitory neurotransmitter in the brain, is also involved in anxiety networks; a transient reduction in GABA transmission increases anxiety in patients and healthy controls, while the anxiolytic impact of benzodiazepines used to treat anxiety is exerted through GABAergic pathways<sup>6</sup>.

As per Norton et al.<sup>18</sup>, although the Hospital Anxiety and Depression Scale is an appropriate approach to emotional distress, its discriminatory power is relatively limited. Nonetheless, this simple measure may be utilized as a baseline screening tool, followed by more validated diagnostic evaluations. However, the lack of consensus over the validity of other scales

or questionnaires to be used in these studies is problematic. In order to avoid unclear outcomes, defined diagnostic research criteria and validated diagnostic tools for both tinnitus and anxiety disorders are necessary and should be a research priority in this field<sup>1</sup>. Meikle et al<sup>7</sup>, developed and validated the Tinnitus Functional Index (TFI)]. The TFI was established to give a scale of tinnitus severity, a classification of tinnitus areas that have an influence on tinnitus severity, and an assessment of change in tinnitus severity. The domains of tinnitus was divided into eight subscales (factors) using exploratory factor analysis intrusiveness, perception of control, cognition, sleep, auditory, relaxation, quality of life, and emotional distress. Because of its responsiveness to treatment-related change, validity for scaling the overall severity of tinnitus, and thorough coverage of many subdomains of tinnitus severity, it should be useful in both clinical and research contexts.

Although the extent of their statistical comorbidity, there is always the dilemma if one disorder is the origin of the other, or do they essentially impact one another's course. There might be an underlying common risk factor, either genetic or physiological in character, that independently causes both diseases in addition to similar contextual factors. This could be explained by larger longitudinal research examining the emergence of the two disorders and the influence of one on the other.

### CONCLUSION

Despite the limited understanding of psychological concerns in tinnitus patients, the prevalence of anxiety disorders in these populations has increased. The reported co-occurrence might impact the disease's clinical course and its management.

Conflict of interest : none

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