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Correlation between Tinnitus Induced Distress and Fatigue in Tinnitus Patients and Characteristics of the Fatigue

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ABSTRACT

This study was to investigate the level and characteristic of fatigue of tinnitus patients, and identify the correlation between tinnitus induced distress and fatigue. Data collection was conducted from May to December 2021. Fatigue Severity Scale, Tinnitus Handicap Inventory Scale were used. We used the data from 102 tinnitus patients. We found that 69.6% of them had fatigue(≥4). The reported factors alleviating fatigue were taking rest, a warm bath, and sleeping. The level of fatigue was higher in subjects with lower perceived health status (p<.001), longer total duration of tinnitus (p<.001), and experienced tinnitus continuously (p =.003). The fatigue was significantly correlated with tinnitus-induced distress. To reduce tinnitus-induced distress, strategies to alleviate tinnitus patient's fatigue are needed.

Keywords
Fatigue; Tinnitus

Introduction

Tinnitus can be defined as the subjective recognition of sound in an absence of such environmental stimulus and can be found even in individuals with no auditory problems [1]. About 10-15% of the total population experiences discomfort from tinnitus and it is shown to become increasingly prevalent in older populations [2-3]. Tinnitus is not the result of any external causes, but it is the voluntary depolarization of the auditory nerve fiber that is recognized as sound [3]. Tinnitus rarely occurs alone and it is common for tinnitus to come with other otological symptoms such as deafness, dizziness, and aural fullness. However, other problems of the neurological, endocrinological, immune system, mental disorders, and ototoxic drugs are also known as potential causes for tinnitus [3]. It is also known that tinnitus patients have their psychological state and sleep quality affected by tinnitus [4-5]. Tinnitus, which is perceived to be louder at night, can wake the affected patients during their sleep, resulting in a decrease in sleep quality and consequently causing similar physical symptoms like chronic fatigue [6]. Adequate rest and sleep are necessary to relieve fatigue, but the presence of this sleeping disorder prolongs the state of physical and mental fatigue without recovery, leading to chronic fatigue [7-8].

Fatigue is the most commonly described symptom by people visiting a hospital [7] and it precedes or accompanies various diseases. Fatigue caused by an underlying disease has the characteristics of not recovering well with simple rest unlike general fatigue [7]. Unrecovered fatigue interferes with exercise and sleep and negatively affects the subject's daily life and social activities [7-8]. Not only can fatigue be easily overlooked because of its diverse and subjective signs and symptoms, but it is also difficult to focus on fatigue itself when there is an underlying disease that needs attention. However, fatigue can worsen the disease, and accumulated fatigue

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can lead to chronic disease [7]. Chronic fatigue can then increase the prevalence of other chronic diseases, which adds economic, physical, and mental pressure to the subject [9]. Therefore, attention to fatigue and a preventative approach is very important.

There are many patients who suffer from the mental and physical exhaustion that tinnitus brings them. There are previous studies that mention such fatigue due to physical and psychological factors of tinnitus [10] but it was difficult to find literature that quantitatively measured fatigue and identified related factors. In addition, the causal relationship between tinnitus and fatigue, if tinnitus causes fatigue or if the fatigue worsens tinnitus, is unclear. In response, this study aims to investigate the correlation between the degree of tinnitus and the characteristics, exacerbation, and alleviation factors of fatigue in patients with tinnitus.

Methods

Research design

This study is a descriptive research study to identify the degree and characteristics of fatigue of tinnitus patients and to confirm its correlation with tinnitus discomfort.

Research subjects

The 102 subjects of this study were selected amongst adult tinnitus patients that were visiting a university hospital located in city D, who understood the purpose of the study, could communicate, and voluntarily agreed to participate in the survey.

G*power program 3.1.9 according to Cohen's formula was used in order to calculate the appropriate sample size for this study under its study design. In the correlation analysis, the minimum number of samples with a significance level of 5%, a statistical power of 90%, and an effect size of 0.3 was calculated as 92, satisfying the size of the sample required for analysis.

Measurements

1) General characteristics

In order to understand the demographic and sociological characteristics of the subjects, gender, age group, presence or absence of cohabitation families, and subjective economic status were investigated. The subjective economic status was surveyed on the Likert 3-point scale ('difficult' 1 point, 'average' 2 points, and 'good' 3 points). Subjective health status was investigated to identify health-related characteristics. The subjective health status was surveyed on the Likert 3-point scale ('healthy' 3 points, 'average' 2 points, and 'bad' 1 point).

2) Fatigue

The fatigue discussed in this study is the investigation of its degree and characteristics. The degree of fatigue was measured using the Fatigue Severity Scale (FSS) developed by Krupp et al. [11] and translated by Chung and Song [12]. The Korean translation tool standardization researcher was contacted through e-mail and approval for the use of this tool was received. The FSS consists of 9 questions about fatigue over the past week that the subjects have to answer on a Likert 7-point scale. The higher the average value of all items, the higher the degree of fatigue, and based on the median of 4 points, participants were divided into a fatigue group and a non-fatigued group [11]. The Cronbach's α=.89 for the original tool, Cronbach's α=.94 for Chung and Song's study [12], and the Cronbach's α=.91 for this study.

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The characteristics of fatigue were measured using the current degree of fatigue and how debilitating it is to daily life on a single-question Numeric Rating Scale (NRS). The most tiring time of the day (After waking up, morning, afternoon, before bed), the duration of (hours), and the number of tiring days in a week (days) were also measured. Factors that exacerbate and alleviate fatigue were measured using multiple responses from subjects' subjective exacerbation and alleviation factors.

3) Characteristics of tinnitus and tinnitus discomfort

In order to grasp the characteristics of tinnitus of the subjects of this study, the timing of tinnitus occurrence and tinnitus patterns were additionally investigated. Tinnitus discomfort was measured using the Tinnitus Handicap Inventory (THI) score. THI is a self-reported scale used to evaluate social and psychological discomfort caused by tinnitus, and in this study, a version developed by Newman et al. [13] originally, and translated by Kim et al. [14] was used. 0 point in the THI scale indicates the mildest discomfort and 100 points indicates the most discomfort due to tinnitus.

Data collection

The data collection was done by three data collectors who were educated in bioethics and understood the characteristics and health of tinnitus patients who further went through training on how to prepare written consent forms and survey content. In order to minimize the difference between data collectors, they were given clear standards and protocols for the survey, and to secure reliability in the data collection process, data collection began after consensus on the evaluation results was reached through preliminary surveys of five same subjects. Data collection was conducted from May 2021 to December 2021 at a university hospital outpatient clinic located in city D. Any volunteers to the survey before the collection of the original data were made sure to be given a thorough explanation of the study and were only admitted if they met the selection criteria and gave written consent. The consent form preparation and the survey were conducted in the form of a 1:1 individual interview, and it took 10-20 minutes per study participant. The accessibility of the collected data was limited to participating researchers, and all collected data was anonymously computerized and used for analysis.

Ethical consideration

In order to protect the study subjects, this study was conducted with the approval (KYU-2020-176-01) of the bioethics committee in Konyang University (Institutional Review Board, IRB) to which the researcher belongs. To prevent leakage of personal information and contents, the questionnaire was entered into the database immediately after collection by the participating researcher, and the consent form and questionnaire were kept in the personal office of the researcher with a lock so that it could not be accessed other than the participating researcher. Allresearch procedures were conducted in compliance with the guidelines recommended by the Research Ethics Committee.

Data analysis

The data of this study were analyzed using the IBM SPSS/WIN 26.0 program(IBM Corp., Armonk, NY, USA), and the specific methods of analysis are as follows.For subject characteristics and tinnitus, fatigue-related characteristics, and tinnitus discomfort, descriptive statistical methods were used to find the frequency, percentage, mean, and standard deviation.

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The difference in fatigue due to different subject characteristics was confirmed using an independent t-test and one-way ANOVA, and then post-tested by the Scheffé test. The correlation between the subject's fatigue and tinnitus discomfort was analyzed using Pearson's correlation coefficient.The level of significance was set at $p < .05$.

Results

General characteristics of the subject

The average age of the subjects in this study was 57.93±4.51, and 57 (55.9%) were women.The subjects living alone were 39 (38.2%), and the subjects with jobs were 59 (57.8%). 30 (29.4%) of the respondents said their economic conditions were bad, and 59 (57.8%) said their health conditions were bad.69 people (65.5%) reported that they had tinnitus for 6 months or more, and 83 people (81.4%) reported that the tinnitus continued to occur (Table 1).

Table 1. General Characteristics and Tinnitus related Characteristics
(N=102)

Variables	Categories	n (%)	Mean±SD
Age (year)	<30	9 (8.8)	57.93±4.51
	30-45	21 (20.6)	
	46-65	37 (36.3)	
	≥65	35 (34.3)	
Gender	Men	45 (44.1)	
	Women	57 (55.9)	
Living alone	Yes	39 (38.2)	
	No	63 (61.8)	
Employed status	Employed	59 (57.8)	
	Unemployed	43 (42.2)	
Perceived economic status	Good	29 (28.4)	2.00±1.21
	Fair	43 (42.2)	
	Poor	30 (29.4)	
Perceived health status	Good	10 (9.8)	2.48±0.88
	Fair	33 (32.4)	
	Poor	59 (57.8)	
Total duration of tinnitus	<3 month	33 (34.5)	
	≥3 month	69 (65.5)	
Characteristics of tinnitus	Intermittent	19 (18.6)	
	Continuous	83 (81.4)	
THI			48.1±4.30

SD=standard deviation; THI=tinnitus handicap inventory

Fatigue characteristics of the subject

Of the subjects in this study, 71 (69.6%) were found to be in the fatigue group, and the average FSS score of all subjects was 4.41±1.39. The NRS score for the degree of fatigue and how

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debilitating it was to daily life was 4.69±2.69, 3.33±2.73 respectively. When asked about the most tiring time of the day, the most common answer was 'before sleep' (40 people, 39.2%). In terms of fatigue duration, 60 people (58.8%) answered more than 3 hours.
Factors that exacerbate fatigue were sleep deprivation (77 people, 75.7%), stress (73 people, 71.6%), and activities to relieve fatigue were sleep (77 people, 75.5%), rest (51 people, 50.0%), and hot water baths (33 people, 32.4%). Daily activities disturbed by fatigue were exercise (44 people, 43.1%), housework (40 people, 39.2%), and social activities (36 people, 35.3%). Nine (8.8%) respondents answered that fatigue did not interfere with their daily life (Table 2).

Table 2. Level and Characteristics of Fatigue
(N=102)

Variables	**Categories**	**n (%)**	**Mean±SD**
FSS score	Fatigue	71 (69.6)	4.41±1.39
	Non-fatigue	31 (30.4)	
Fatigue severity (NRS)			4.69±2.46
Level of fatigue interference in daily activities (NRS)			3.33±2.73
The most fatigued time (per day)	After awakening	20 (19.6)	
	Morning	14 (13.7)	
	Afternoon	28 (27.5)	
	Before sleep	40 (39.2)	
Duration of fatigue	Less than 3hours	42 (39.2)	
	More than 3hours	60 (58.8)	
Frequency of fatigue (per week)	1~2days	7 (6.9)	
	3~4dyas	24 (23.5)	
	5~6days	27 (26.5)	
	Always	44 (43.1)	
Aggravating factors of fatigue†	Stress	73 (71.6)	
	Pain	24 (23.5)	
	Depression	22 (21.6)	
	Sleep deficiency	77	

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		(75.5)
	Exercise	18 (17.6)
	None	10 (9.0)
Relieving factors of fatigue†	Warm bath	33 (32.4)
	Exercise	26 (25.5)
	Rest	51 (50.0)
	Sleep	77 (75.5)
	Food intake	14 (13.7)
	Others	9 (8.8)
	Exercise	44 (43.1)
Interference with daily activities due to fatigue†	Household chores	40 (39.2)
	Social activities	36 (35.3)
	Others	19 (18.6)
	None	9 (8.8)

FSS=fatigue severity scale; NRS=numeric rating scale
†Multiple responses

Fatigue difference due to different characteristics of the subjects

As a result of examining the perceived difference in fatigue due to different characteristics of the subjects, subjectively bad health status (p<.001), less than 6 months of tinnitus experience (p <.001), and continued occurrence of tinnitus (p=.003) all lead to significantly higher fatigue level (Table 3).

Table 3. Fatigue according to Characteristics of Tinnitus Patients
(N=102)

Variables	Categories	FSS	t or F	p
Age (year)	<30	4.26±1.19	-2.64	.109
	30-45	4.39±1.38		
	46-65	4.46±1.21		
	≥65	4.52±1.14		
Gender	Men	4.21±1.19	-0.91	.363
	Women	4.61±1.30		
Living alone	Yes	4.54±1.29	1.97	.161

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	No	4.29±1.28		
Employed status	Employed	4.28±1.25	0.28	.782
	Unemployed	4.46±1.30		
Perceived economic status	Good	4.44±1.29	-0.81	.397
	Fair	4.32±1.30		
	Poor	4.60±1.21		
Perceived health status	Good[a]	3.68±1.30	-35.62	<.001
	Fair[b]	4.25±1.31	a<b<c[‡]	
	Poor[c]	5.62±1.75		
Total duration of tinnitus	<3 month	5.15±1.20	7.51	<.001
	≥3 month	3.92±1.10		
Characteristics of tinnitus	Intermittent	3.97±1.21	-3.00	.003
	Continuous	4.91±1.27		

FSS=Fatigue Severity Scale
[†]Multiple responses; [‡]Scheffe test

Correlation between tinnitus discomfort and fatigue

Examining the correlation between fatigue and tinnitus discomfort measured by THI, THI has a significant positive correlation (r=.25, p=.029) with fatigue (Table 4).

Table 4. Correlation of Fatigue with Tinnitus Induced Distress
(N=102)

Variables	Fatigue	THI
	r (p)	r (p)
Fatigue	1	
THI	.25 (.029)	1

THI=tinnitus handicap inventory

Discussions

This study was conducted to understand the degree and characteristics of fatigue in tinnitus patients, subjective factors for deteriorating and alleviating fatigue, the differences in fatigue due to different characteristics of subjects, and to investigate the correlation between fatigue and tinnitus discomfort. 69.6% of the study subjects were found to be in the fatigue group. This number corresponds to a very high percentage compared to the elderly fatigue group using welfare centers with about two chronic diseases [15].

The fatigue of all subjects was measured at 4.41 points, higher than that of elderly people in welfare centers, 3.41 points [15] and outpatient stroke patients, 2.85 points [16] when measured using the same tool. 81.4% of the subjects reported having persistent tinnitus, and the average age was 57.9 years old. The average age of the subjects was lower than the average age (74.9 years

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old) of the elderly in the welfare center and the average age (61.2 years old) of outpatient stroke patients.

In general, aging in individuals leads to a decrease in physiological functions and makes them prone to various chronic diseases. This, in turn, increases fatigue as well as slows the recovery of such fatigue [17]. The fact that the degree of fatigue in tinnitus patients was higher than that of the elderly in their 70s with chronic diseases is a testament to its significance.

Overseas qualitative studies on the symptom experience of tinnitus patients complained of loss of quietness due to the unstopping sound in the ear [10], but the results of this study show how serious the fatigue caused by continuous sound exposure is.

The worse the subjective health condition of an individual was, the higher their fatigue was. This result supports previous studies [15]. It is possible that the fact that both of them are subjective symptoms leads to a significant correlation between subjective health status and fatigue. The underlying diseases of the subjects were not investigated in this study future studies might benefit from further investigating the underlying diseases of the subjects to see if there is any relevance to the fatigue caused by tinnitus.

The degree of fatigue was higher in subjects that had tinnitus for less than 6 months and had tinnitus occur continuously (Table 3). Tinnitus that persists for more than 6 months gets classified as chronic tinnitus in general [18]. It was expected for subjects with continuous tinnitus to report a higher degree of fatigue, but it was unexpected for subjects with tinnitus for less than 6 months to have a low degree of fatigue. These results are considered to reflect the situation in which patients of tinnitus gradually adapt and accept tinnitus. The change of perspective on tinnitus is a very important factor in adapting to life with tinnitus as there is no clear cure for it to date [19].

The correlation analysis of the relationship between fatigue and tinnitus discomfort indicated a significant positive correlation. In other words, it was confirmed that tinnitus discomfort increased as fatigue increased. However, it is still unclear whether tinnitus discomfort increases fatigue or fatigue increases tinnitus discomfort. A prospective intervention study will be required to find various intervention measures that can alleviate fatigue and then evaluate the degree of tinnitus discomfort to confidently determine which causesthe others.

The factors for exacerbating and alleviating fatigue were investigated in this study, and sleep problems were the common factor. Previous studies also state that sleep quality is estimated to be an important factor influencing tinnitus discomfort [20] and the results of this study also support this assumption. Therefore, it will be meaningful to understand the relationship between fatigue in tinnitus patients and sleep patterns such as sleep quality, sleep satisfaction, and the number of awakenings during sleep.

It is difficult to generalize the research results to all tinnitus patients since this study analyzed the data collected from tinnitus patients from one university hospital in Daejeon. However, the understanding of the degree of fatigue, characteristics of such fatigue, and the confirmation of sleep problems being the most frequent factor of fatigue exacerbation bear meaning, especially amidst such lack of research on the fatigue of tinnitus patients.

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Conclusion

The fatigue of the subjects of this study was higher than that of previous studies, and fatigue was higher in subjects that reported worse on their subjective health status, had it occurred less

than 6 months ago, and had it occur continuously. It cannot be said that there is a single reason for fatigue, but the result of this study points out the most frequent cause is sleep problems. Therefore, this study considers it necessary to understand the relationship between fatigue and sleep quality, sleep satisfaction, and the number of awakening during sleep of tinnitus patients in the future. Finally, this study calls for an investigation to find ways to relieve fatigue and attention in fatigue so that subjects who continue to experience tinnitus do not suffer from chronic fatigue.

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