



# The Impact of Tinnitus on Fibromyalgia

Chong Hyuk Chung, M.D.\*, Gyuho Jang, M.D. \*, Chang-Hoon Lee, M.D., Ph.D.

Division of Rheumatology, Department of Internal Medicine, Wonkwang University School of Medicine, Iksan, Korea

**Objective.** Fibromyalgia (FM) is a disorder characterized by chronic diffuse pain and enhanced pain response to stimuli and is caused by central sensitization. Tinnitus also is related to central sensitization. So we investigated the impact of tinnitus on FM. **Methods.** We included 22 FM patients with tinnitus and 25 FM patients without tinnitus. We assessed a range of symptoms using the Widespread Pain Index; Symptom Severity Score scale; Visual Analogue Scale of pain; and the Korean versions of the Fibromyalgia Impact Questionnaire (FIQ), the Insomnia Severity Index, and the Short-form Health Survey (SF-36). Information about the severity of tinnitus in FM patients was evaluated using the Korean version of the Tinnitus Handicap Questionnaire (THQ-K). **Results.** There were significant differences between the group that had mild tinnitus (THQ < 38) and the group that had moderate-to-severe tinnitus (THQ ≥ 38) for FIQ score ( $p=0.025$ ) and for the physical functioning ( $p=0.003$ ), social functioning ( $p=0.035$ ), and mental health ( $p=0.017$ ) components of the SF-36. Also, after dividing patients into 2 groups according to insomnia severity, significant differences were observed in FIQ score ( $p=0.002$ ) and in body pain ( $p=0.001$ ), general health ( $p=0.008$ ), vitality ( $p=0.003$ ), social functioning ( $p=0.003$ ), role limitation due to emotional condition ( $p=0.001$ ), and mental health ( $p<0.001$ ) components of the SF-36. **Conclusion.** The FM patients with severe tinnitus had more functional impairments and lower quality of life than those with mild tinnitus. Severe insomnia also was accompanied by worse health status and lower quality of life. (*J Rheum Dis* 2021;28:31-37)

**Key Words.** Fibromyalgia, Tinnitus, Insomnia, Quality of life

## INTRODUCTION

Fibromyalgia (FM) is a disorder characterized by chronic diffuse muscle pain due to an exaggerated response to peripheral stimuli known as central sensitization [1-3]. The prevalence of FM rates varies from 2% to 11% in the general population but has predominance in middle-aged female [2,4].

FM frequently accompanies centrally mediated symptoms such as fatigue and non-restorative sleep [5]. Some patients with FM have distressing neuropsychiatric symptoms and functional impairments [2]. It is well-known that otologic symptoms such as dizziness, hearing loss, and tinnitus also often associate with FM [6,7].

The cause of tinnitus is not well known in most cases, so there is no curative treatment [8]. Recently, there is increasing evidence that changes in the central nervous system such as central gaining and centralization are associated with tinnitus [9]. But the relationship between tinnitus and FM is not well understood. In this study, we evaluated the impact of tinnitus on FM.

## MATERIALS AND METHODS

### Patients

We conduct a cross-sectional survey of participants who were identified through an advertisement from a single rheumatology outpatient clinic at Wonkwang University Hospital. Patients were recruited from March 2020 through

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**Corresponding to :** Chang-Hoon Lee  <http://orcid.org/0000-0002-7351-3806>

Division of Rheumatology, Department of Internal Medicine, Wonkwang University School of Medicine, 895 Muwang-ro, Iksan 54538, Korea. E-mail : lch110@nate.com

\*These authors contributed equally to this work.

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May 2020 and were eligible for enrollment if they were at least 18 years old and had FM according to the classification criteria of the American College of Rheumatology [10]. Exclusion criteria were evidence of organic brain disease or organic otolaryngological illness.

### Ethics statement

The local Institutional Review Board (IRB) approved this study (IRB no. 2019-12-029-002). Written informed consent was obtained from all patients before study entry.

### Study variables

Demographic (age and sex) and clinical variables (FM duration, FM-associated symptoms, location and severity of tinnitus (if present), irritable bowel syndrome symptoms, and insomnia severity) were collected through a standard protocol of questionnaires. Core measures of FM symptoms and comorbidities were assessed by Korean-validated scores and scales: Widespread Pain Index (WPI); Symptom Severity Score (SSS) Scale [10]; Visual Analogue Scale (VAS) of pain; and the Korean versions of the Fibromyalgia Impact Questionnaire (FIQ) [11], the Insomnia Severity Index (ISI-K) [12], the Tinnitus Handicap Questionnaire (THQ-K) [13], and the Short-form Health Survey (SF-36) [14,15].

WPI and SSS scale are used to diagnose FM. The WPI captures the number of painful areas reported over the previous week by FM patients over a range from 0~19. The SSS scale assesses the severity of symptoms in FM patients and ranges from 0~12, with higher scores indicating greater severity [10].

The THQ is a self-reporting tinnitus questionnaire, validated in Korean, which consists of 27 items that sum to a total score ranging from 0 (no handicap) to 100 (catastrophic difficulties) [13].

To compare quality of life between FM patients with and without tinnitus, we used three questionnaires: 1) the SF-36 is a self-administered questionnaire, validated in Korean, that assesses eight health-related quality-of-life dimensions: physical functioning, role limitation due to physical condition, body pain, general health, vitality (energy and fatigue), social functioning, role limitation due to emotional condition, and mental health. Each scale is scored using norm-based methods, with higher scores indicating better health. Scores are aggregated further to produce physical and mental component summary measures of health status, using norm-based methods. The subscale scores are standardized and range from 0~100,

with higher scores reflecting higher health-related quality of life in the measured domain [15].

2) The FIQ is a self-administered questionnaire, validated in Korean, to assess health-related quality of life over the previous week, specifically in patients with fibromyalgia. It consists of VAS questions and those regarding limitations in daily living activities. The total score ranges from 0~100, with higher scores indicating greater negative impact [11].

3) The ISI is a self-report questionnaire, validated in Korean, to assess the nature and severity of insomnia. It consists of 7 components that sum to a total score ranging from 0 (no difficulties) to 28 (severe difficulties) [12].

### Statistical analysis

Data obtained from the questionnaires were analyzed

**Table 1.** Baseline characteristics

Patient characteristics	All patients (n = 47)
Age (yr)	53.8 ± 8.8
Sex, female	44 (93.6)
Fibromyalgia duration (mo)	83.7 ± 58.2
Widespread Pain Index (range: 0~19)	10.5 ± 5.0
Symptom Severity Score (range: 0~12)	7.2 ± 2.2
VAS of pain* (range: 0~100)	68.2 ± 18.7
Fibromyalgia Impact Questionnaire (range: 0~100)	62.8 ± 18.0
Insomnia Severity Index (range: 0~28)	15.4 ± 6.6
SF-36	
Physical functioning	40.2 ± 20.6
Role limitation due to physical condition	26.0 ± 34.6
Bodily pain	36.2 ± 18.1
General health	32.3 ± 13.8
Vitality (energy and fatigue)	26.9 ± 14.5
Social functioning	46.8 ± 22.0
Role limitation due to emotional condition	39.0 ± 45.7
Mental health	40.7 ± 17.7
Health change	30.3 ± 27.6
Associated symptoms	
Tinnitus	22 (46.8)
Headache	41 (87.2)
Irritable bowel syndrome <sup>†</sup>	6 (12.7)
Used medication <sup>‡</sup>	34 (72.3)

Values are presented as mean ± standard deviation or number (%). SF-36: Short-form Health Survey. \*The Visual Analogue Scale (VAS) of pain intensity is a 100-point linear gauge in which 0 = no pain and 100 = worst pain imaginable. <sup>†</sup>Satisfies the Rome IV diagnostic criteria. <sup>‡</sup>Medication including selective serotonin reuptake inhibitor/serotonin-norepinephrine reuptake inhibitor/Pregabalin.

using SPSS software version 26 (IBM Co., Armonk, NY, USA). We conducted comparative analyses via chi-square test for qualitative variables and by t-test and one-way ANOVA for quantitative variables. The Mann-Whitney U-test and Kruskal-Wallis test were used when the comparison group distribution was non-normal according to the Shapiro-Wilk test. Statistical significance was at the 5% level. All the tests were two-sided.

## RESULTS

All 47 FM patients completed the study protocol. About 90% are women and suffered from headache. Also, about half the patients had tinnitus. Widespread moderate-to-severe pain, insomnia, and decreased quality of life were also observed (Table 1).

While we found a mildly significant difference between the 22 FM patients with tinnitus and the 25 FM patients

without tinnitus with regard to SSS ( $p=0.051$ ), there were no statistical differences in demographics and clinical variables between the two groups (as shown in Table 2).

Among the 22 patients who had tinnitus and FM, two did not answer the Tinnitus Handicap Questionnaire. Our study showed significant differences between patients with mild tinnitus ( $THQ < 38$ ) and patients with moderate-to-severe tinnitus ( $THQ \geq 38$ ) for FIQ ( $p=0.025$ ) and the physical functioning ( $p=0.003$ ), social functioning ( $p=0.035$ ), and mental health ( $p=0.017$ ) components of the SF-36 (Table 3). These results suggest that FM patients who had more severe tinnitus had more severe FM symptoms and suffered more negative impacts on their quality of life.

When we divided FM patients into two groups by insomnia severity (insomnia grade 1~2 and insomnia grade 3~4), we found significant differences in FIQ ( $p=0.002$ ) and in bodily pain ( $p=0.001$ ), general health ( $p=$

**Table 2.** Comparison between Fibromyalgia patients with and without tinnitus

Variable	Fibromyalgia with tinnitus (n = 22)	Fibromyalgia without tinnitus (n = 25)	p-value
Age (yr)	54.5 ± 9.3	53.1 ± 8.4	0.828 <sup>§</sup>
Sex			0.629 <sup>¶</sup>
Male	1 (4.5)	2 (8.0)	
Female	21 (95.5)	23 (92.0)	
Fibromyalgia duration (mo)	81.7 ± 61.6	85.5 ± 56.3	0.828 <sup>§</sup>
Widespread Pain Index	11.9 ± 5.3	9.2 ± 4.6	0.710 <sup>  </sup>
Symptom Severity Score	7.9 ± 2.0	6.6 ± 2.3	0.051 <sup>§</sup>
VAS of pain*	72.5 ± 17.6	64.4 ± 19.2	0.140 <sup>  </sup>
Fibromyalgia Impact Questionnaire	66.5 ± 17.8	59.7 ± 18.0	0.199 <sup>§</sup>
Insomnia Severity Index	14.4 ± 6.6	16.2 ± 6.6	0.350 <sup>§</sup>
SF-36			
Physical functioning	37.0 ± 17.9	43.0 ± 22.7	0.329 <sup>§</sup>
Role limitation due to physical condition	27.2 ± 35.2	25.0 ± 34.6	0.825 <sup>  </sup>
Bodily pain	34.7 ± 19.3	37.6 ± 17.2	0.583 <sup>  </sup>
General health	30.0 ± 13.5	34.4 ± 14.0	0.281 <sup>§</sup>
Vitality (energy and fatigue)	27.5 ± 14.1	26.4 ± 15.1	0.799 <sup>  </sup>
Social functioning	48.9 ± 22.1	45.0 ± 22.2	0.554 <sup>§</sup>
Role limitation due to emotional condition	44.0 ± 48.7	34.7 ± 43.5	0.494 <sup>  </sup>
Mental health	42.7 ± 19.4	38.9 ± 16.2	0.463 <sup>§</sup>
Health change	28.4 ± 28.1	32.0 ± 27.5	0.661 <sup>  </sup>
Associated symptoms			
Headache	20 (90.9)	21 (84.4)	0.670 <sup>¶</sup>
Irritable bowel syndrome <sup>†</sup>	5 (22.7)	1 (4.0)	0.085 <sup>¶</sup>
Used medication <sup>‡</sup>	15 (68.2)	19 (76)	0.550 <sup>¶</sup>

Values are presented as mean ± standard deviation or number (%). SF-36: Short-form Health Survey. \*The Visual Analog Scale (VAS) of pain intensity is a 100-point linear gauge in which 0=no pain and 100=worst pain imaginable. <sup>†</sup>Satisfies the Rome IV diagnostic criteria. <sup>‡</sup>Medication including selective serotonin reuptake inhibitor/serotonin-norepinephrine reuptake inhibitor/Pregabalin. <sup>§</sup>t-test; <sup>||</sup>Mann-Whitney U-test; <sup>¶</sup>chi-square test.

**Table 3.** Comparison between Fibromyalgia patients with mild tinnitus and moderate-to-severe tinnitus

Severity of tinnitus	Tinnitus grade 1 ~ 2 (n = 12)*	Tinnitus grade 3 ~ 5 (n = 8)*	p-value
Age (yr)	55.2 ± 7.5	53.2 ± 13.0	0.666 <sup>  </sup>
Sex			0.209**
Male	0 (0)	1 (12.5)	
Female	12 (100)	7 (87.5)	
Fibromyalgia duration (mo)	81.7 ± 63.7	98.3 ± 58.7	0.561 <sup>  </sup>
Tinnitus duration (mo)	46.8 ± 43.0	111.6 ± 119.5	0.178 <sup>  </sup>
Tinnitus side			0.303**
Left side	1 (8.3)	0 (0)	
Right side	6 (50.0)	2 (25.0)	
Both sides	5 (41.7)	6 (75.0)	
Widespread Pain Index	10.8 ± 4.5	14.1 ± 6.4	0.192 <sup>¶</sup>
Symptom Severity Score	7.6 ± 2.0	8.8 ± 1.9	0.206 <sup>  </sup>
VAS of pain <sup>†</sup>	70.8 ± 13.8	80.6 ± 20.1	0.211 <sup>  </sup>
Fibromyalgia Impact Questionnaire	63.6 ± 11.9	78.6 ± 15.6	0.025 <sup>  </sup>
Insomnia Severity Index	13.9 ± 5.9	17.8 ± 5.4	0.160 <sup>  </sup>
SF-36			
Physical functioning	43.3 ± 10.5	21.9 ± 17.3	0.003 <sup>  </sup>
Role limitation due to physical condition	25.0 ± 28.2	15.6 ± 35.2	0.517 <sup>¶</sup>
Bodily pain	37.9 ± 20.0	24.1 ± 19.8	0.107 <sup>  </sup>
General health	30.4 ± 9.4	23.8 ± 14.3	0.223 <sup>¶</sup>
Vitality (energy and fatigue)	30.4 ± 14.4	18.8 ± 9.2	0.058 <sup>  </sup>
Social functioning	55.2 ± 20.3	34.4 ± 19.8	0.035 <sup>  </sup>
Role limitation due to emotional condition	47.2 ± 48.1	25.0 ± 46.3	0.318 <sup>¶</sup>
Mental health	49.3 ± 16.7	29.0 ± 17.6	0.017 <sup>  </sup>
Health change	31.3 ± 28.5	12.5 ± 13.3	0.065 <sup>¶</sup>
Associated symptoms			
Headache	11 (91.7)	7 (87.5)	1**
Irritable bowel syndrome <sup>‡</sup>	1 (8.3)	4 (50.0)	0.109**
Used medication <sup>§</sup>	6 (50.0)	8 (100)	0.042**

Values are presented as mean ± standard deviation or number (%). SF-36: Short-form Health Survey. \*Tinnitus grade was calculated using the Tinnitus Handicap Questionnaire. <sup>†</sup>The Visual Analog Scale (VAS) of pain intensity is a 100-point linear gauge in which 0=no pain and 100=worst pain imaginable. <sup>‡</sup>Satisfies the Rome IV diagnostic criteria. <sup>§</sup>Medication including selective serotonin reuptake inhibitor/serotonin-norepinephrine reuptake inhibitor/Pregabalin. <sup>||</sup>t-test; <sup>¶</sup>Mann-Whitney U-test; \*\*chi-square test.

0.008), vitality (p=0.003), social functioning (p=0.003), role limitation due to emotional condition (p=0.001), and mental health (p<0.001) components of the SF-36 (Table 4). This suggests that insomnia severity has a positive correlation with FM severity and a negative correlation with quality of life in FM patients.

## DISCUSSION

In this study, we evaluated the association between tinnitus severity and FM. Previous studies demonstrate that tinnitus and FM have a common pathophysiology, called central sensitization. Also, the conditions are treated with similar drugs. However, no previous studies have ex-

plored links between them.

In this study, 93.6% of the 47 FM patients were female and their mean age was 53.8±8.8 years. A recent study investigated 86 FM patients in South Korea, among whom 94.4% were female and their mean age was 50.9±11.8 years [11], which is consistent with the high prevalence of FM in middle-aged women. We showed that 46.8% and 87.2% of the 47 FM patients had tinnitus and headache, respectively, suggesting a high incidence of these symptoms in FM. Koca et al. [16] found that FM patients had more otologic symptoms, including tinnitus and high level of oxidative stress. In another study, 74.3% of 101 FM patients had tinnitus despite having audiological test results in the normal range [7]. Herein, we confirm that fi-

**Table 4.** Comparison of Fibromyalgia patients by insomnia severity

Severity of insomnia	Grade 1~2 (n = 19)	Grade 3~4 (n = 28)	p-value
Age (yr)	55.9±8.9	52.4±8.5	0.177 <sup>§</sup>
Sex			0.060 <sup>¶</sup>
Male	3 (15.8)	0 (0)	
Female	16 (84.2)	28 (100)	
Fibromyalgia duration (mo)	67.0±50.9	95.1±61.0	0.104 <sup>§</sup>
Widespread Pain Index	10.2±4.8	10.6±5.3	0.795 <sup>§</sup>
Symptom Severity Score	6.3±2.4	7.9±1.9	0.019 <sup>  </sup>
VAS of pain*	53.3±16.3	67.7±16.9	0.116 <sup>  </sup>
Fibromyalgia Impact Questionnaire	53.4±18.3	69.2±15.0	0.002 <sup>§</sup>
SF-36			
Physical functioning	43.2±19.8	38.2±21.3	0.426 <sup>§</sup>
Role limitations due to physical condition	43.4±41.5	14.3±21.0	0.013 <sup>  </sup>
Bodily pain	46.6±17.6	29.2±14.9	0.001 <sup>  </sup>
General health	38.7±13.2	28.0±12.7	0.008 <sup>§</sup>
Vitality (energy and fatigue)	35.8±16.5	20.9±9.2	0.003 <sup>  </sup>
Social functioning	57.9±15.7	39.3±22.7	0.003 <sup>§</sup>
Role limitations due to emotional condition	66.7±44.4	20.2±36.7	0.001 <sup>  </sup>
Mental health	53.1±16.7	32.3±13.0	<0.001 <sup>§</sup>
Health change	40.8±27.9	23.3±25.4	0.028 <sup>  </sup>
Associated symptoms			
Headache	15 (78.9)	26 (92.9)	0.204 <sup>¶</sup>
Irritable bowel syndrome <sup>†</sup>	2 (10.5)	4 (14.3)	1 <sup>¶</sup>
Tinnitus	11 (57.9)	11 (39.3)	0.210 <sup>¶</sup>
Used medication <sup>‡</sup>	14 (73.7)	20 (71.4)	0.865 <sup>¶</sup>

Values are presented as mean ± standard deviation or number (%). SF-36: Short-form Health Survey. \*The Visual Analog Scale (VAS) of pain intensity is a 100-point linear gauge in which 0=no pain and 100=worst pain imaginable. <sup>†</sup>Satisfies the Rome IV diagnostic criteria. <sup>‡</sup>Medication including selective serotonin reuptake inhibitor/serotonin-norepinephrine reuptake inhibitor/Pregabalin. <sup>§</sup>One-way ANOVA test; <sup>||</sup>Kruskal-Wallis test; <sup>¶</sup>chi-square test.

bromyalgia frequently accompanies tinnitus. Furthermore, we show that the more severe is the tinnitus, the more severe are the FM symptoms and the lower is the quality of life, all of which cause limited physical activity and mood disturbance.

Our study suggests that tinnitus is a key component of centrally mediated symptoms in FM, indicating that tinnitus severity is closely related to FM severity and should be assessed in all FM patients. Due to altered neurological processing known as central sensitization, FM patients feel pain associated with peripheral nociceptive stimuli more acutely (allodynia) and more intensely (hyperalgesia) [2]. Centrally mediated symptoms such as fatigue, sleeplessness, and mood disturbance are characteristics in central sensitization [1,5]. There is some evidence that FM patients have increased activation of a pain-related brain lesion and significant imbalances among pain-processing areas and cognition-attention networks of the brain [1].

Also, evidence suggests that the activity of centrally acting neurotransmitters is altered in FM. Russell et al. [17,18] investigated the neurotransmitters in FM patients and found elevated level of substance P and reduced levels of serotonin, norepinephrine, and dopamine in the cerebrospinal fluid. Furthermore, centrally acting drugs such as serotonin-norepinephrine reuptake inhibitors (SNRIs), tricyclic antidepressants, and gabapentinoids are used to treat FM. These drugs not only have an analgesic effect, they also diminish centrally mediated symptoms in FM patients [5,19]. From these findings, we hypothesize that the imbalance of neurotransmitters in central sensitization plays an essential role in FM. Additionally, assuming that tinnitus is a result of imbalance in neurotransmitters, we found that FM severity correlated with tinnitus severity rather than tinnitus presence, as shown in Tables 2 and 3. Moreover, we assume that drugs taken to treat FM will also affect tinnitus.

We could confirm that the rate of taking drugs such as selective serotonin reuptake inhibitors, SNRI and pregabalin was significantly higher in the moderate-to-severe tinnitus group than in the mild tinnitus group, as shown in Table 3 ( $p=0.042$ ). In a single, small study that evaluated the efficacy of some FM drugs for tinnitus, pregabalin and duloxetine were found to alleviate tinnitus in FM patients but not to a statistically significant degree between pregabalin and duloxetine [7]. More research about the effectiveness of these drugs for tinnitus is needed.

Numerous studies have found that reduced input of peripheral sensory neurons activates homeostatic plasticity to result in central sensitization. Noreña and Farley [9] suggested that this process ultimately causes tinnitus, even if hearing loss is not detected in the audiogram. Additionally, centralization of tinnitus may become progressive over time, making it less dependent on peripheral sensory input. So, there is a possibility that tinnitus is one of the aggravating causes of FM, not a result of FM. Therefore, it may be appropriate to evaluate and treat tinnitus early in FM patients.

We predicted that tinnitus severity would be associated with insomnia severity in FM patients, but we found no meaningful difference between the mild tinnitus and moderate-to-severe tinnitus groups in Insomnia Severity Index scores ( $p=0.16$ ; Table 3). This may be due to our small sample size. Further studies are needed to better evaluate these associations. A cross-sectional survey showed that poor quality of sleep is associated with increased pain intensity and decreased quality of life in women with FM [20]. Our study also concluded that insomnia is a significant symptom of FM and should be carefully evaluated.

To our knowledge, this is the first study of the impact of tinnitus in FM patients. We concluded that tinnitus severity is related to FM severity and lower quality of life. We also reconfirmed that insomnia severity has a positive correlation with FM severity and an inverse correlation with quality of life, as shown in Table 4. However, we found no significant correlation between tinnitus presence and FM severity.

Our study has some limitations. First, this was a study conducted in a tertiary hospital, our participants may represent a subset of patients with more severe FM symptoms than would be expected in FM patients overall. Second, we performed a single-center cross-sectional study. Third, we could not measure the hearing capacity

in tinnitus group since the patients had difficulty getting a hearing test at the otolaryngology clinic for time reasons. Fourth, due to our small sample size, we used non-normal distribution tests. Further large-scale, multicenter, and cohort studies are necessary.

## CONCLUSION

FM patients with severe tinnitus have more functional impairments and lower quality of life than patients with mild tinnitus. Insomnia severity also has a positive correlation with poor health status and lower quality of life in FM patients. We identified a need for early evaluation and treatment of tinnitus and the significance of insomnia in FM patients.

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## CONFLICT OF INTEREST

No potential conflict of interest relevant to this article was reported.

## AUTHOR CONTRIBUTIONS

C.H.L. designed the study. C.H.L., C.H.C., and G.H.J. drafted the manuscript. C.H.C. and G.H.J. contributed to the acquisition and analysis of data. C.H.C. and G.H.J. contributed equally to this manuscript. All authors approved the final manuscript.

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