RESEARCH ARTICLE

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Psychological Acceptance of Tinnitus Symptoms Alleviates the Associated Depression and Sleep Impairments

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ABSTRACT

Objective: Tinnitus is frequently accompanied by symptoms of depression and sleep impairments, so elucidating the direct and indirect associations among these conditions may lead to more broadly effective treatments. This study investigated the correlations, moderating effects, and mediating effects among these conditions in patients receiving Oriental medicine for tinnitus treatment.

Design: Surveys on tinnitus, depression, and insomnia severity as well as psychological acceptance of tinnitus were conducted at 15.

Study Sample: Oriental medicine clinics and hospitals in South Korea, and 123 complete responses were analyzed.

Results: Significant correlations were detected among psychometric tinnitus disorder, depression, sleep disorder, and psychological acceptance scores. In addition, pathway analyses revealed that tinnitus independently promoted depression and sleep disorders, while depression promoted sleep dysfunction directly and partially mediated the effect of tinnitus on sleep dysfunction. Psychological acceptance weakened the impact of tinnitus on depression and the mediating effect of depression on the indirect tinnitus-sleep disorder pathway.

Conclusions: Therapies designed to promote psychological acceptance of tinnitus may alleviate depressive symptoms, improve sleep, and ultimately enhance quality of life.

Keywords: Tinnitus disorder; Depression; Sleep Disorder; Psychological Acceptance.

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INTRODUCTION

The prevalence of tinnitus among Korean adults is currently 20.27%, and is increasing progressively due to growth in the population over 60 years of age. In fact, a substantial surge in prevalence is anticipated due to the rapidly aging population (Research Institute for Healthcare Policy and Korean Medical Association 2019)[1]. This increasing prevalence is a critical issue for medical and mental health practitioners as tinnitus patients frequently exhibit comorbid physical and psychological symptoms that diminish quality of life (Research Institute for Healthcare Policy and Korean Medical Association 2019), leading to decreased occupational and social capabilities[2,3]. Therefore, interdisciplinary research is required to determine the causes of tinnitus and the associated comorbidities for more effective treatments.

Among the most common and severe psychological symptoms experienced by patients with chronic tinnitus are sleep disorders and depression, which may stem from disillusionment with symptomatic treatment[4]. Moreover, the subjective severity of tinnitus appears to correlate with the frequency and severity of depression and anxiety[4].

However, these psychological symptoms are not inevitable, as even individuals with severe tinnitus who shifted their perspective to acceptance were found to experience psychological peace and relief from depressive symptoms[1,4]. Thus, the presence and severity of tinnitus itself does not necessarily induce depression or sleep disorders. Rather, whether the patient perceives tinnitus as stressful and how effectively they can accept discomfort are major determinants of psychological comorbidity[5].

Despite the frequency and severity of psychological sequela, most studies on tinnitus have focused on pathology, auditory symptoms, and medical treatments. Indeed, the diverse causes of tinnitus are well known, as are the associations of etiology with specific symptoms. However, little research has been done in Korea on the psychological effects of tinnitus or on the potential efficacy of psychological treatment approaches.

The effect of psychological acceptance on the level of clinical discomfort from tinnitus provides a valuable clue to improved comprehensive treatment approaches. This study examined the influence of individual psychological characteristics, including acceptance of tinnitus symptoms, on comorbid depression and sleep disorders among patients with tinnitus. We speculated that psychological acceptance of tinnitus symptoms would influence the association of tinnitus with depression and sleep dysfunction. Therefore, we conducted pathway analyses to evaluate a possible mediating effect of depression on the association of tinnitus with sleep disorders and the potential moderating effects of psychological acceptance on the tinnitus–depression pathway and on mediation of the indirect tinnitus–sleep disorder pathway by depression.

MATERIALS & METHODS

Ethical approval

This study was approved by the Institutional Review Board of Seoul Cyber University, Approval No. AN01-20230209-HR-001-01. All participants provided written informed consent prior to participation. Participants voluntarily provided information without any monetary compensation and gave written informed consent prior to participation.

Participants and data collection

Adults aged 19–65 years seeking treatment at traditional Korean medicine clinics for persistent or intermittent tinnitus of at least one month's duration were considered candidates for this study. All were examined by direct pure tone audiometry, impedance audiometry, and tinnitus degree tests and those0.unsuitable for the study based on diagnostic results, such as objective tinnitus, middle ear disease, underlying internal disease, or psychiatric treatment effects, were excluded from consideration. Study subjects were selected by random sampling based on sample size calculations using the G-power program. According to sample size calculations, 115 subjects were required for the correlation analysis to achieve 0.two-tailed significance for H1 ($\rho \neq 0$) versus the null hypothesis (H0: $\rho = 0$) with α-error = 0.05 and statistical power of 0.95, while 107 subjects were required for multiple regression analysis to detect an effect size of 0.15 for two test predictors with α-error = 0.05 and statistical power of 0.95. Thus, a minimum sample of 115 was needed, and considering a potential nonresponse rate, an additional five subjects were added for 120 in total.

Patients included in the study were verbally informed of the methods and purpose of the research, and those who wished to participate provided written informed consent before survey. This study was conducted with the approval of the Institutional Review Board of Seoul Cyber University Institutional Review Board (Approval number: AN01-20230209-HR-001-01). The survey introduction stipulated that personal information and data would remain confidential according to the Statistics Act of South Korea.

Measurement tools

The severity of tinnitus impairment was assessed using the Korean version of the Tinnitus Handicap Inventory (THI), a self-report scale developed by[6-8]. It is among the most widely used scales for assessing tinnitus symptom severity as well as the associated psychological effects. Unlike other available assessments, the THI was designed for simplicity of administration and interpretation. The THI identifies and quantifies functional, emotional, and catastrophic symptoms of tinnitus, thereby establishing a baseline at the initial clinical visit for evaluating subsequent treatment efficacy [9]. The 25 items are scored on a three-point Likert scale as follows: 0 ("no"), 1 ("sometimes"), and 2 ("yes"). A larger cumulative scores is indicative of more severe tinnitus impairment with high reliability (Cronbach's $\alpha = 0.949$).

Beck depression inventory

The Korean version of the Beck Depression Inventory (BDI-K) was employed to measure the severity of depression. The BDI-K is an extensively validated screening instrument for depression in Korean primary healthcare settings and a convenient tool for treatment evaluation. It includes 21 items scored on a four-point Likert scale (0–3), with higher total score indicating greater depression severity. For item 19 stating "I have recently lost weight," the additional clause "I am currently trying to lose weight by controlling my food intake" was added. For respondents currently trying to lose weight, responses to 19 were recoded as 0, signifying "not applicable." The reliability of the Korean version has been confirmed (Cronbach's $\alpha = 0.873$).

Pittsburgh sleep quality index

To assess sleep disturbances, we utilized the Korean Version of the Pittsburgh Sleep Quality Index (PSQI-K). This self-report tool queries various sleep metrics, including sleep latency and sleep duration, sleep habits, sleep disturbances, medication use, and daytime dysfunction over the past month. The 18 items are categorized into seven domains. A 2020 study reported a Cronbach's alpha of approximately 69%, as well as0.a significant correlation of over 67% between PSQI-K scores and metrics from the Fitbit tracker[10]. The PSQI-K also demonstrated 93% sensitivity and 84% specificity for distinguishing sleep disorder patients from controls[10]. In the current study, we used 14 items from the PSQI-K, including 10 assessing sleep problems, one assessing overall sleep quality, one on medication use, and two evaluating daytime drowsiness and concentration. All items were scored on a four-point Likert scale (0–3), with higher cumulative scores indicating greater severity of sleep disturbances. For reliability t, the PSQI-K in this study showed a Cronbach's $\alpha = 0.678$.

Acceptance and action questionnaire-II

The Acceptance and Action Questionnaire-II (AAQ-II), an enhanced version of the Acceptance and Action Questionnaire (AAQ) developed by[11] targeting the general population, was applied to measure psychological acceptance. Kim and Kim (2008) reported significant convergent, discriminant, and criterion-related validity in their validation study of the AAQ-II. The AAQ-II consists of 10 items rated on a seven-point Likert scale (with three responses reverse-coded) ranging from 0 ("Not at all true") to 6 ("Always true"), with higher aggregate scores indicating lower levels of psychological acceptance. The reliability test for AAQ-II yielded a Cronbach's $\alpha = 0.645$.

Summary of tools

Presents a summary of the measurement tools applied in this study (**Table 1**).

Methods of analysis

All analyses were conducted using SPSS Statistics 25.0 and Hayes's PROCESS macro[12]. The analytical procedures were as follows. First, frequency analysis was conducted to identify the demographic characteristics. Second, descriptive statistics (means and standard deviations) were calculated and Pearson's correlation analysis performed for measured variables. Third, Hayes's PROCESS macro Model 4 was used to investigate mediation effects, Model 1 to investigate moderation effects, and Model 7 to investigate moderation of mediation. This analytic strategy was based on[13], who employed Hayes's PROCESS macro to examine moderated mediation effects and emphasized that demonstrating mediation and moderation effects is crucial for validating the moderated mediation model.

RESULTS

A total of 123 questionnaires were administered and collected from February 2 to February 23, 2023. The demographic characteristics of the survey respondents are summarized (**Table 2)**. In general, demographic characteristics (such as the age distribution) are reflective of the clinical tinnitus population in South Korea.

Correlations among psychometric scores

The mean scores for tinnitus severity as measured by the THI, depression severity as measured by the BDI-K, sleep disorder as measured by the PSQI-K, and capacity for psychological acceptance as assessed by the AAQ-II are shown for the 123 respondents (**Table 3**). The absolute skewness and kurtosis values did not exceed 3 and 10, respectively, so each dataset satisfied the assumption of normality[14]. Therefore, Pearson's correlation analyses were conducted to assess associations among measurements.

As shown (**Table 4**), all variables were positively correlated. Further, all correlations were relatively strong (ranging from $r = 0.362$ for PSQI-K vs. AAQ-II to $r = 0.611$ for BDI-K vs. AAQ-II) and highly significant (all p

Table 1. Composition of the measurement tool items.

Variable		Number of questions	Type of scale
Independent variable	Tinnitus disorder	25	Three-point Likert scale
Mediating variable	Depression	21	Four-point Likert scale
Dependent variable	Sleep disorder	14	Four-point Likert scale
Control variable	Psychological acceptance	10	Seven-point Likert scale
Demographic factors (gender, age, occupation, education level)		4	Nominal scale
Total number of questions		74	

Table 2. Demographic characteristics.

		Frequency	Percent (%)
Gender	Male	66	53.7
	Female	57	46.3
Age (years)	20–29	2	1.6
	30–39	8	6.5
	40–49	16	13
	50–59	42	34.1
	≥60	55	44.7
Job	Office	46	37.4
	Outdoor	11	8.9
	Combined Indoor–outdoor	19	15.4
	Student	3	2.4
	Jobless	44	35.8
Educational level	Middle school education or less	12	9.8
	High school diploma or less	37	30.1
	Associate's degree	14	11.4
	Bachelor's degree or higher	60	48.8
Total		123	100

Table 3. Descriptive statistics of the main variables.

Variable	Min.	Max.	M	SD	Skewness		Kurtosis	
					Statistic	SE	Statistic	SE
Sleep disorder	0.00	28.00	11.72	6.04	0.54	0.22	−0.04	0.43
Psychological acceptance	1.00	42.00	16.71	8.24	0.43	0.22	0.13	0.43
Tinnitus disorder	0.00	49.00	17.18	11.95	0.55	0.22	−0.53	0.43
Depression	0.00	25.00	8.12	6.78	0.89	0.22	−0.13	0.43

M, mean; SD, standard deviation; SE, sum of errors

Table 4. Correlations between variables.

	Tinnitus disorder	Depression	Sleep disorder	Psychological acceptance
Tinnitus disorder	1			
Depression	0.594**	1		
Sleep disorder	0.473**	0.496**	1	
Psychological acceptance	0.456**	0.611**	0.362**	1

**$p < 0.01$

< 0.01) Note that higher THI, BDI-K, and PSQI-K scores are indicative of greater severity while higher AAQ-II score reflects diminished psychological acceptance. Thus, psychological acceptance tended to decrease with the severity of tinnitus, depression, and sleep dysfunction.

Direct, mediating, and moderating effects among tinnitus, depression, sleep disorder, and psychological acceptance

Tinnitus directly influences depression and sleep disorder severity, while depression directly influences sleep disorder severity and partially mediates the effect of tinnitus on sleep.

Model 4 from Hayes's PROCESS macro was utilized to assess the direct effects of tinnitus on depression and sleep disorder, the direct effect of depression on sleep disorder, and the mediating effect of depression on the tinnitus–sleep disorder association pathway. For bootstrap validation, a sample of 5,000 was set, and the confidence interval was set to 95%[12] for evaluation of each model. The significance for each path was verified first (**Table 5**). Tinnitus severity significantly and directly influenced depression severity ($t = 8.12$, $p < 0.001$) 0.0.and sleep disorder severity ($t = 5.90$, $p < 0.001$), and depression severity also directly0.influenced sleep disorder severity ($t = 3.49$, $p < 0.01$). Tinnitus directly promoted depression ($\beta = 0.34$, $p < 0.001$) and sleep disorder ($\beta = 0.24$, $p < 0.001$), and depression likewise directly promoted sleep dysfunction ($\beta = 0.30$, $p < 0.01$).

In addition, depression partially mediated the effect of tinnitus on sleep disorder severity (indirect effect size 0.10) (**Table 6**). This indirect mediating effect was significant because the interval between the lower and upper bounds of the confidence interval did not include 0, indicating that tinnitus exerts an indirect positive influence on sleep disorder severity (i.e., exacerbates sleep disorder severity) through depression.

The results of bootstrapping validation are shown (**Table 7**). The significance of mediation by depression is indicated by the upper and lower bounds of the confidence interval

Table 5. Direct pathways among tinnitus disorder, depression, and sleep disorder.

Path	β	SE	t	p	LLCI	ULCI
Tinnitus disorder → depression	0.34	0.04	8.12	0.000	0.25	0.42
Depression → sleep disorder	0.30	0.08	3.49	0.001	0.13	0.46
Tinnitus disorder → sleep disorder	0.24	0.04	5.90	0.000	0.16	0.32

***p < 0.001, **p < 0.01

Table 6. Indirect effect of tinnitus disorder on sleep disorder through depression.

Path	Effect	Boot SE	BootLLCI	BootULCI
Tinnitus disorder → Depression → Sleep disorder	0.10	0.03	0.03	0.17

BootLLCI, bootstrapped lower level confidence interval; BootULCI, bootstrapped upper level confidence interval

Table 7. Significance of the mediating effect verified by bootstrapping.

	Boot value	Boot SE	95% confidence interval	
			BootLLCI	BootULCI
M − 1SD	0.04	0.02	0.00	0.07

BootLLCI, bootstrapped

not including 0 (B = 0.04, 95% CI [0.00, 0.07]).

lower level confidence interval; BootULCI, bootstrapped upper level confidence interval

These direct and indirect influences are illustrated in (**Figure 1**).

Psychological acceptance moderates the influence of tinnitus on depression

We then examined the potential moderating effect of psychological acceptance on the relationship between tinnitus and depression using Model 1 of Hayes's PROCESS macro (**Table 8**). Tinnitus r (t=5.49, p<0.001) and psychological acceptance (t=5.48, p<0.001) directly influenced depression, and0.the interaction between tinnitus and psychological acceptance also significantly influenced depression (t = 2.88, p<0.01).

Therefore, we further examined if the conditional effect of psychological acceptance as the moderating variable was also significant (**Table 9**) and found significance at the mean (M), one standard deviation (SD) below the mean (M − 1SD), and one SD above the mean (M+1SD). As zero was not included within the confidence interval, the moderating effect was deemed significant.

Provides an illustration of this moderating effect (**Figure 2**). According to the PROCESS macro, high versus low tinnitus severity and degree of psychological acceptance as distinguished according to mean − 1SD and mean + 1SD, respectively, did not include zero. The values for sleep disturbance (y-axis) were derived for each code. The graph shows that as tinnitus severity increases, sleep disturbance severity also increases. However, when the degree of psychological acceptance is high, the effect on sleep due to tinnitus is reduced. These moderating effects are summarized in (**Figure 3**).

Moderating effect of psychological acceptance on the indirect relationship between tinnitus and sleep disorder via depression

We then examined if psychological acceptance moderates the direct tinnitus–sleep disorder pathway and the mediating effect of depression on the indirect tinnitus–sleep disorder pathway using0.Model 7 of Hayes's PROCESS macro. A bootstrap sample of 5,000 was set for the verification of significance, with a confidence interval of 95%[10]. As shown in (**Table 10**), tinnitus disorder (t = 5.49, p < 0.001) and psychological acceptance (t = 5.48, p < 0.001) significantly influenced depression, and a significant interaction effect of tinnitus disorder × psychological acceptance on depression was also detected (t = 2.88, p < 0.01). Further analyses indicated that tinnitus disorder (t = 2.89, p < 0.001) and depression (t = 3.49, p < 0.001) significantly influenced sleep disorder. The strength of the indirect effect of tinnitus on sleep disorder through depression increased significantly as psychological acceptance score increased (indicating lower psychological acceptance). Moreover, the moderating effect of psychological acceptance on the direct tinnitus–sleep disorder pathway was also statistically significant.

To verify the significance of the research model, bootstrapping was conducted (**Table 11**). Again, the range covering the mean (M), one SD below the mean (M − 1SD), and one SD above the mean (M + 1SD) did not include 0, confirming the significance of the moderated mediation model.

The results are summarized graphically in (**Figure 4**).

DISCUSSION

This study investigated the pathways from tinnitus disorder to depression and sleep disorders among adult patients seeking tinnitus treatment at Korean traditional medicine clinics. The main findings of the study are as follows. First, significant positive correlations were detected among tinnitus disorder, depression, and sleep disorder severity scores, suggesting reciprocal exacerbation of symptoms. In addition, higher severity scores for all three disorders were correlated with poorer psychological acceptance (indicated by higher

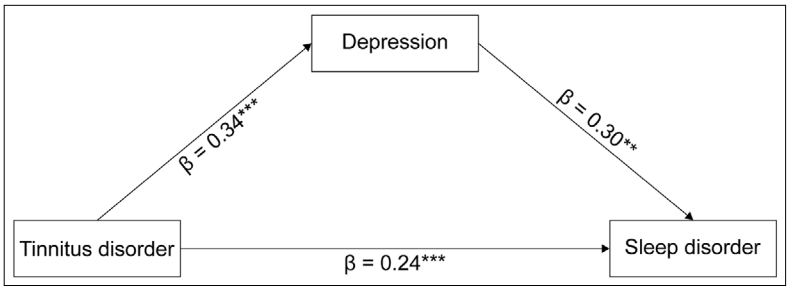

Figure 1. Testing for mediating effects.

Table 8. Moderating effect of psychological acceptance on the influence of tinnitus disorder on depression.

Dependent	Prediction	B	SE	t	p	LLCI	ULCI
Depression	(Constant)	7.59	0.46	16.43***	0.00	6.67	8.50
	Tinnitus disorder	0.22	0.04	5.49***	0.00	0.14	0.30
	Psychological acceptance	0.32	0.06	5.48***	0.00	0.21	0.44
	Tinnitus disorder × Psychological acceptance	0.01	0.04	2.88**	0.004	0.0038	0.0202
		F = 45.0626, p = 0.000 R2 = 0.5318					

Table 9. Significance of the moderating effect on the tinnitus–sleep disorder pathway verified by bootstrapping.

Psychological acceptance	Effect	SE	t	p	LLCI	ULCI
M − 1SD	0.12	0.05	2.34	0.027	0.01	0.28
M	0.22	0.04	5.49	0.000	0.14	0.29
M + 1SD	0.32	0.05	6.21	0.000	0.22	0.42

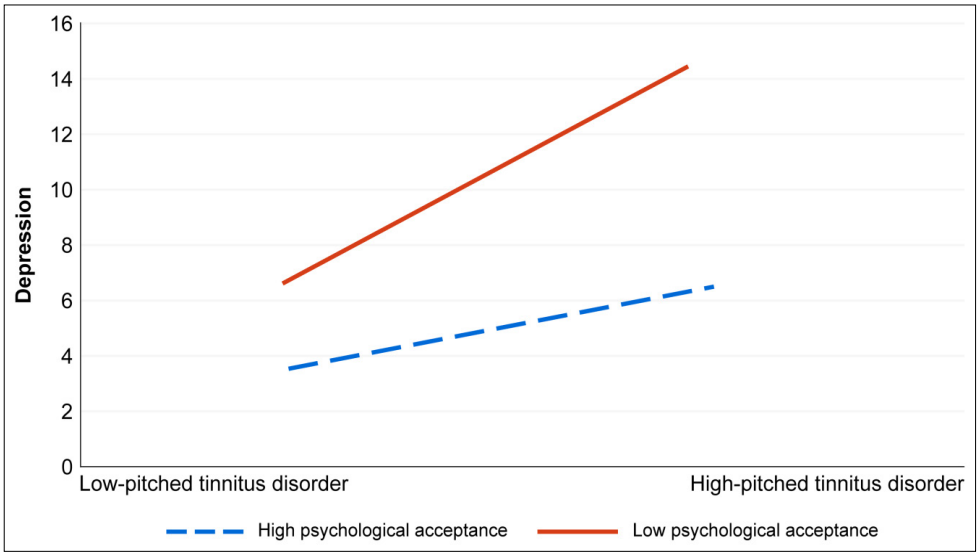

Figure 2. Moderating effect of psychological acceptance.

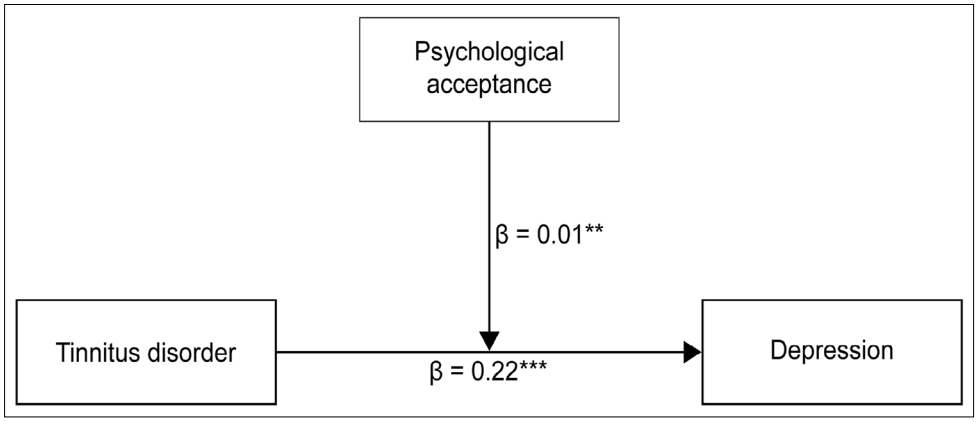

Figure 3. Moderation effect verification.

Table 10. Moderated mediation analysis.

Dependent	Prediction	B	SE	t	p	LLCI	ULCI
Depression	(Constant)	7.59	0.46	16.43***	0.00	6.67	8.50
	Tinnitus disorder	0.22	0.04	5.49***	0.00	0.14	0.30
	Psychological Acceptance	0.32	0.06	5.48***	0.00	0.21	0.44
	Tinnitus disorder × Psychological acceptance	0.01	0.04	2.88**	0.004	0.0038	0.0202
	F = 45.0626, p =0.0.000 R2 = 0.0.5318						
Sleep Disorder	(Constant)	9.31	0.83	11.21***	0.00	7.66	10.95
	Tinnitus disorder	0.14	0.05	2.89***	0.00	0.04	0.23
	Depression	0.30	0.08	3.49***	0.00	0.13	0.46
	F = 25.1491, p = 0.000 R^2 = 0.2954						

***p < 0.001, **p < 0.01

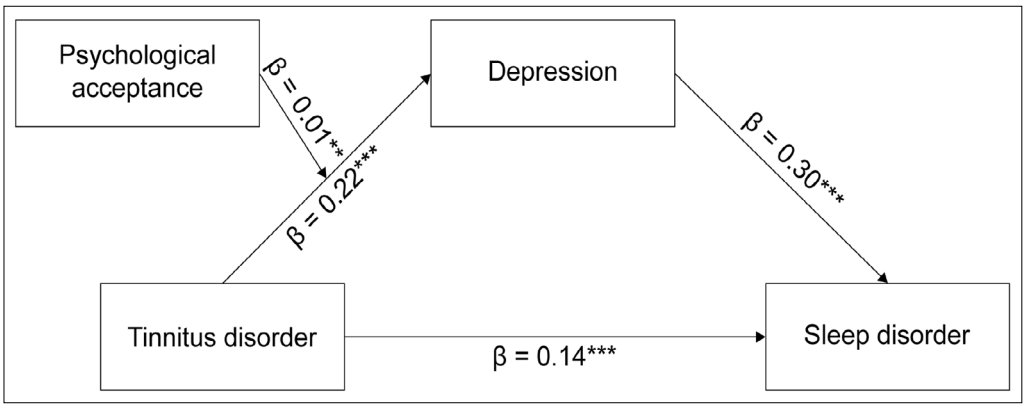

Figure 4. Validation of the research model.

scores on the AAQ-II). These findings are consistent with previous reports that perceived discomfort from tinnitus exacerbates sleep disorder symptoms[15,16], depression symptoms[17], or both[18]. Second, we detected a direct association pathway from tinnitus to sleep disorder and an indirect pathway mediated by depression (i.e., in which tinnitus disorder impacts depression, which subsequently influences sleep disorder). Another clinical study involving roughly 100 patients similarly reported that depression severity increased with the duration of tinnitus[19] and that depression promoted sleep disorders. Thus, sleep impairments among tinnitus patients may be treated more effectively by addressing tinnitus and depressive symptoms. Third, psychological acceptance moderated the tinnitus–depression pathway, implying that greater perception of tinnitus symptoms exacerbates depressive symptoms. Alternatively, greater psychological acceptance reduced the propensity of tinnitus to induce depressive symptoms, supporting0. earlier work suggesting that psychological acceptance can mitigate depression[20,21]. Fourth, psychological acceptance also moderated the impact of depression on the indirect tinnitus–sleep disorder pathway (moderated mediation). In other words, psychological acceptance can weaken the indirect association between tinnitus and sleep disorder by alleviating depression and thereby reducing the mediating effect of depression. In accord with these findings[1,5] reported that the acceptance of tinnitus and the suppression of painful emotions associated with the discomfort can genuinely alleviate distress caused by tinnitus.

At present, the most widely applied psychological intervention for tinnitus is cognitive behavioral therapy (CBT), as this strategy has proven effective for0.the treatment of a myriad of mental health conditions including depression, anxiety disorders, posttraumatic stress disorder, substance use disorder, eating disorders, insomnia, and interpersonal problems[6,7]. However, therapies grounded in acceptance such as mindfulness-based cognitive therapy and acceptance and commitment therapy have attracted greater attention for tinnitus disorder in recent years[17,22,23]. In addition,[7] reported that relaxation techniques, which are a component of internet-based CBT (ICBT), were effective for the alleviation of tinnitus symptoms, and a follow-up study proposed intervention measures for ICBT targeting behavioral changes in patients with tinnitus[7]. These studies further indicate that while traditional CBT or mindfulness-based cognitive therapy can be beneficial, it is essential to consider individual variations in sound perception and psychological responses to tinnitus. For this reason, psychological interventions tailored to these individual differences are necessary for the treatment of patients with tinnitus and comorbid psychological symptoms. In particular, an integrated approach promoting acceptance of the stress related to tinnitus could be most effective for reducing the frequency and severity of depression and sleep disturbances caused by tinnitus.

These findings have potential implications for actual clinical practice. By promoting psychological acceptance, individuals can better control the anxiety and stress caused by tinnitus, which in turn would0.reduce depressive symptoms. Psychological acceptance also has the potential to enhance awareness of the relationships among tinnitus, depression, and sleep disturbances, providing therapeutic pathways for improved sleep such as alleviating depression. Moreover, this form of acceptance could facilitate adaptive strategies for tinnitus and sleep disturbances, allowing0.individuals to better manage the tinnitus–sleep disturbance pathway. Tinnitus, depression, and sleep disturbances are interconnected symptoms or states, so addressing one issue via psychological acceptance may help alleviate the others.

This study's value lies in its empirical validation of psychological acceptance as a moderator of the association between tinnitus and depression and the influence of depression in the indirect tinnitus–sleep disorder pathway, thereby providing clues to treatment strategies not ascertainable by tinnitus research focused solely on clinical symptoms and pathology. Further, this study emphasizes the importance of therapeutic strategies to alleviate the physical and mental challenges experienced by patients with tinnitus, including psychological acceptance. Moreover, these insights may be applicable to other chronic pain conditions associated with depression, anxiety, and sleep dysfunction.

Based on these findings, we recommend therapeutic programs to enhance the acceptance of tinnitus symptoms and thereby alleviate the associated distress. For instance, the use of acceptance and commitment therapy (ACT–), a form of CBT emphasizing mental flexibility, can support psychological acceptance. The core of this approach focuses on acceptance and nonjudgmental awareness, enabling individuals to improve control over their thoughts and emotions, thereby promoting psychological well-being and reducing distress. Other potential interventions include mindfulness-based stress reduction (MBSR) and mindfulness-based cognitive therapy (MBCT)[24]. In support of these strategies,[25] found that higher levels of mindfulness were associated with reduced stress and psychological distress related to tinnitus, while[26] reported that nearly all participants with tinnitus experienced a reduction in negative thinking and distress related to their disorder following MBCT. In addition, a notable alleviation was seen in negative emotions (including depression, anxiety, fear, and anger), other daily difficulties (including stress, insomnia, and interpersonal conflicts), and avoidance behaviors. These findings suggest that psychological interventions such as MBSR and MBCT can help reduce negative thoughts and reactions to tinnitus and assist in the adoption of a more positive and accepting attitude toward the condition.

We show that psychological acceptance is a moderating variable in the relationships among tinnitus, depression, and sleep dysfunction, suggesting that therapeutic promotion of acceptance could enhance psychological well-being and reduce stress. This approach emphasizes the acceptance of one's thoughts and feelings without judgment or attachment[27]. Through such programs, it is anticipated that patients with tinnitus can develop the ability to recognize and accept their emotions when experiencing physical and psychological pain (such as from tinnitus). While traditional otolaryngological interventions have been prioritized for patients with tinnitus to alleviate symptoms, techniques to develop psychological acceptance may be effective complementary treatments by helping patients regulate their emotions and maintain a positive mindset[28,29].

One major implication of this study is the need to understand the psychological and mental state of patients with tinnitus and to develop and actively utilize personalized programs focused on enhancing the ability to recognize and accept the pain caused by tinnitus. Such efforts may help patients with tinnitus lead a healthier life. It is hoped that more effective therapeutic interventions will emerge from continue research on the psychopathological pathways initiated by tinnitus.

CONCLUSION

We note some limitations of this study and provide recommendations for subsequent research. One significant limitation is the reliance on self-reported responses, which inherently limits objectivity. Responses to self-report psychological surveys can be influenced by factors such as respondent's memory, subjective interpretations, and social desirability bias, which in turn can affect data quality and reliability. To address this limitation, future research should consider implementing test–retest measurements or utilize more objective neural signal measurements such as electroencephalography. Second, the sample may not truly reflect the Korean population as patients were recruited from among those visiting a traditional Korean medicine clinic. Future studies should therefore consider alternative sampling methods or expanding data collection to encompass diverse demographic factors, such as age, residence, and treatment setting. Third, this research primarily emphasized the associations among tinnitus, depression, and sleep disorders, although there could be other influencing variables. For instance, previous studies have suggested associations with other cognitive and psychological factors, including stress, anxiety, and cognitive impairments. Therefore, for the comprehensive alleviation of symptoms and the development of effective treatment programs for patients with tinnitus, it is imperative to consider a broader range of variables. This will facilitate a more accurate and holistic understanding of the causes of and potential treatments for tinnitus.

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