

The Role of Psychological Factors in Tinnitus

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Based on the limitation of biomedical model of tinnitus, more attention has been paid to personalities or psychological aspects. Depressive disorder, anxiety disorder, and sleep disturbance were comorbid illnesses of tinnitus and research showed that neurobiological mechanisms such as dysfunction of limbic system or HPA axis were common in tinnitus and affective disorders and that comorbid psychiatric disorders enhanced the negative outcome of tinnitus. Recently, more attention is being paid to the relation of tinnitus with personality and the role of stress. Although the causal relation of personality and tinnitus is unclear, stress in itself showed that it can be a trigger in the development of tinnitus, and stress of tinnitus can cause adverse effects. Since the effect of fear-related cognition such as catastrophic thought about tinnitus was revealed more recently, its therapeutic implication should be explored. This review will describe the product of previous research and discuss future direction about psychological factors related to tinnitus.

Key Words: Tinnitus; Psychology, Psychiatric Disorder; Personality; Stress

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INTRODUCTION

Tinnitus is usually perceived as a continuous buzzing, hissing or ringing sound in the ears [1]. Subjective tinnitus, the most common form of tinnitus is only perceived to a tinnitus patient and there is no corresponding sound source. On the contrary, the perceived noise has its source within a patient's body in objective tinnitus cases. About 90% of all tinnitus cases are accompanied by hearing loss [2] which is a risk factor of tinnitus [3].

Even though it is a fact that tinnitus has a high prevalence and results in disturbances, researchers assume that the mechanism to develop and maintain tinnitus is not fully understood [4]. Previous research showed that 35-45% of adults have subjective tinnitus at some point in their life [5], 8-15% of adults suffer from tinnitus [6], and 18% of people in industrialized societies are mildly affected by chronic tinnitus [7]. However, it is not clear what the factors are for onset, persistence, severity, and adverse effect of tinnitus. There had been some biomedical models explaining the relation between tinnitus and a physiological mechanism, neurological

mechanism, and immunological mechanism, which were supported by some empirical studies.

These models showed limitations to find out the cause and result of tinnitus, and since then, more attention has been paid to other factors beyond the biomedical models. One of the most popular factors was personalities or psychological aspects. This review will deal with psychological factors related to tinnitus through the empirical studies done so far and discuss the direction of future studies on personality factors. Before reviewing the relation between tinnitus and personality aspects further, the issue of psychiatric disorders needs to be addressed. Knowing the effects of psychiatric disorders on tinnitus is helpful to understand neurological causes of tinnitus as well as to find out the neurological changes caused by tinnitus because psychiatric disorders include the physical mechanism. It is also helpful to understand the personality or temperament factors since psychiatric disorders embrace the psychological explanation of tinnitus.

CORMOBID PSYCHIATRIC DISORDERS AND ITS OUTCOME

There is a lot of research on comorbidity of tinnitus and psychiatric disorders. Depressive disorder and anxiety disorder are mentioned most, but the proportions of the relation with tinnitus are quite different. First, 10-74% of chronic tinnitus patients suffer from depressive disorder and 28-49% from anxiety symptoms [8]. Another study showed that 48-60% of chronic tinnitus patients suffer from major depressive disorder [9], and the prevalence of those diagnosed with current depressive disorder was 33-74% [10].

These differences in percentages are due to the variations in the types of tinnitus patients that were included in the study samples or the type of diagnostic criteria of psychiatric disorders that were used in the studies. Another research showed that 45-78% of the patients with tinnitus satisfied the criteria of one or more psychiatric disorders [9]. Besides, affective or mood disorder described above, and sleep disturbance were also revealed as comorbid disorders [8]. In other words, tinnitus can cause sleeping problems, and it in turn can lead to concentration difficulties [10].

However, chronic physical illnesses such as chronic pain disorder [11], asthma [12], and atopic dermatitis [13] can cause or be comorbid with depression, anxiety, and somatization. Compared to these chronic physical illnesses, it is necessary to study what kinds of psychiatric disorders are comorbid with tinnitus. A research on the comorbidity found that the rates of the comorbidity between chronic tinnitus and psychiatric disorders were not higher than those between chronic tinnitus and chronic physical illnesses [5]. Specifically, 25% of tinnitus patients had somatoform disorder based on the criteria of ICD-10 whereas 38-47% had other chronic physical illnesses, and 23.5% of tinnitus patients had affective disorder whereas 21-24% had other chronic diseases. However, an interesting result was obtained when tinnitus was divided into decompensated (complex) type and compensated type. Namely, patients with decompensated tinnitus had more psychiatric disorders than those with compensated tinnitus (77% and 39.5% respectively) [14].

The results from the research mentioned above definitely show the comorbidity of tinnitus with psychiatric disorders. In particular, the comorbidity with affective or mood disorders is the most common although the percentages of the comorbidity are different among the tinnitus studies. Moreover, psychiatric disorders can increase the possibility of several negative effects caused by

tinnitus. Hearing problems itself can cause difficulties in understanding speech in noise, decreased hearing sensitivity, hyperacusis, hearing loss, and tinnitus [15]. There was a correlation between tinnitus severity and depression in tinnitus patients [8] and the severity of tinnitus was correlated with the frequency of depressive symptoms in patients with depressive disorder [16]. Annoyance caused by tinnitus was correlated with the severity of anxiety and depression and sleep disturbance [17]. Additionally, a higher level of distress was associated with increased frequency of depressive disorders, ineffective coping strategies, and a higher rate of morbidity in patients with tinnitus [18].

Sleep disturbance due to tinnitus can lead to considerable distress in daily life and social function [19]. Social dysfunction of patients with tinnitus was aggravated by psychiatric problems. A study examined that patients with both tinnitus and depressive disorders presented higher psychosocial disabilities than non-depressive tinnitus sufferers [9].

The question is if people with difficulties of mood or affect are more vulnerable to tinnitus or vice versa, that is, tinnitus causes mood disturbance biologically or psychologically. Previous research supports the latter that tinnitus can cause negative effects including mood disorders. For instance, a cohort study with 2,800 participants showed that tinnitus reduced the quality of life [20] and another study revealed that 50% of patients got depressed [21]. However, the former is still possible, which means the possibility of a common mechanism explaining both the risk of tinnitus and the vulnerability of psychological distress. Research on this possibility can be roughly divided into two categorizations: research on neurobiological mechanism of tinnitus and personality factors in tinnitus.

NEUROBIOLOGICAL MECHANISM AND ITS COVERAGE WITH PSYCHIATRIC DISORDERS

It has been suggested that after cochlear damage, a cascade of changes occurs in the central auditory pathways and some of these may serve as a 'neural code' for tinnitus. Most researchers agree with this perspective [22]. Moreover, tinnitus was known as being related to reorganization of the homolateral auditory cortex as well as increased gamma-band activity in the contralateral auditory cortex. The entity of this reorganization showed a positive correlation with the severity of tinnitus [23]. Therefore researchers concluded that reorganization of the auditory cortex induced by hearing loss seemed to be one of the main sources of the tinnitus symp-

tom [24], and it was proposed that changes in patients having tinnitus present enhanced spontaneous firing rates in central acoustic pathways [25]. Recent research demonstrated the relevance of central nervous structures for the pathophysiology of tinnitus [26].

More than those neuronal, cortical, and biological mechanisms described above, the limbic system HPA axis is the conduit between tinnitus and psychological features. Some researchers demonstrated that a significant loss of volume in the subcallosal area of tinnitus sufferers and other limbic structures have been found to be involved [27]. The subcallosal area is a poorly delineated area of the brain and constitutes a major hub linking affective areas and the thalamo-cortical system involved in perception. A normally functioning HPA axis is a requirement for hearing and clinical studies show that tinnitus patients display signs of an impaired HPA-axis along with higher degrees of perceived stress, compared to non-tinnitus patients [28]. The conclusions are often drawn from the concentrations of individual hormones such as cortisol. Many of the anabolic and catabolic stress hormones and many hormones of the immune system are intertwined in patterns that are not fully understood [15]. In addition, neuroimaging studies confirm that some neural circuits are activated by both depression and tinnitus, and neuroendocrine function show alteration of the HPA axis in both depressed patients and tinnitus patients [29].

Although neurobiological mechanism can explain both tinnitus and the vulnerability of some psychiatric disorders, it cannot clarify the onset, persistence, severity, and comorbidity of tinnitus. Still, there is a possibility that personality factors can affect the causes and results of tinnitus.

PERSONALITY FACTORS IN TINNITUS

'Personality' is a common construct in the field of psychology. This concept is a stable and consistent personal characteristic, which is referred to as a factor continuously affecting an individual's behavior or behavior potential. Since personality inheres in a person and persists continuously, it can affect the onset, persistence, and related distress of tinnitus. Or personality may influence the way patients deal with tinnitus or its persistence. In general, the most popular factors of personality are introversion, extraversion, affectivity or emotionality, and so on. Research on the associations between the personality factors and tinnitus examined various characteristics of personality and investigated their correlations. However, even though the personality factors exam-

ined in research are various, the results are inconsistent or still under debate to make a conclusion. In this section, the results from empirical research conducted so far will be discussed.

Relatively early research went along with research exploring the comorbidity of psychiatric disorders. In other words, it was unclear whether measured factors in research were closer to stable personality or they reflected psychiatric distress. For instance, tinnitus patients were tested by MMPI in some research, but typical MMPI profiles of chronic tinnitus were not shown [30,31]. It could be due to the characteristic of assessment tool, that is, MMPI. A primary factor assessed from MMPI is a level of psychiatric disorders. The results of MMPI are interpreted as the characteristics of personality when there are no psychiatric symptoms or disorders, but otherwise, an individual's personality is covered with symptoms or disorders. Therefore, the results of MMPI are confused unless it is divided into those who have psychiatric disorders and those who do not.

The concepts such as trait-depression or trait-anxiety were studied. These factors were higher in people with hearing loss who are suffering from tinnitus [32], and they were found to act as increasing pain caused by tinnitus after having tinnitus [33,34]. Another research showed that trait-anxiety was correlated with tinnitus-related distress [35]. This research implies that people who have stable and characteristic depression or anxiety, not just state-depression or state-anxiety caused by physical illnesses, are unlikely to adaptively cope with pain such as hearing loss or tinnitus. However, trait-depression or trait-anxiety is originally highly correlated with state-depression or state-anxiety. In other words, it is not clear that trait-depression or trait-anxiety measured in research represents either only stable and long-lasting personality or current emotional distress. For this reason, redundant parts are statistically removed and then analyzed in abundant empirical research. It is hard to find the results drawn in this way in previous research on tinnitus and trait-depression or trait-anxiety.

Another group of research examined the association between tinnitus and the relatively stable characteristics of personality based on the personality theory. Extraversion, conscientiousness, agreeableness, openness, and neuroticism (or emotional stability) suggested in Big-Five theory, a representative theory of personality, or well-known factors of personality such as self-esteem were covered in those research. The results showed that somatic symptoms in tinnitus patients were correlated with neuroticism or negative affectivity [36], and tinnitus patients had higher levels of neuroticism,

negative affectivity and social inhibition but lower levels of extraversion and emotional stability than people in a control group [37]. These findings imply that some factors of personality can be related to whether tinnitus exists or not, or pain caused by tinnitus. The factors whose effects were consistently confirmed by research were neuroticism, negative affectivity, extraversion, and social inhibition. However, neuroticism and negative affectivity can have conceptually or empirically redundant portion since neuroticism originally has a tendency towards depression, anxiety, or anger and includes emotional stability. Considering that extraversion and social inhibition can have a negative correlation, it is summarized that the common factors whose effects were consistently supported from research were neuroticism and social inhibition (social desensitization).

The effects of these two factors in tinnitus were repeatedly confirmed by research on Type D personality. Type D personality is a joint personality trait of negative affectivity and social inhibition. Type D personality is correlated with tinnitus-related distress [37], and among ear-nose-and-throat patients, those who had tinnitus showed a higher level of Type D personality than those who did not.

Through what mechanism are Type D personality or neuroticism and social inhibition associated with tinnitus through? It can be explained in the psychosocial or neurobiological view. First, those with high levels of neuroticism or those who are emotionally unstable are likely to negatively cope with physical illnesses such as tinnitus by experiencing negative emotion more strongly or by thinking negatively. People who are inhibited or people who have low levels of extraversion are unlikely to share their symptoms about negative events such as tinnitus with other people, to actively seek supports, or to get enough emotional support from others in order to cope with some pain. However, the psychosocial theory can properly explain tinnitus severity or tinnitus-related pains, but not the onset of tinnitus or whether tinnitus exists or not. In this case, neurobiological theory is still valid, that is, the dysfunction or abnormality of limbic system or HPA axis might cause emotional instability or negative affectivity.

The psychological factors dealt with in research on personality were changed from emotional responses at certain points of time to stable and consistent factors. Also, the interests in research were moved from comprehensive and various personality factors to pain-related or stress-related factors. This trend of research is relatively consistent with the direction of research on personality related to specific behavioral problems or pathology in the field of

psychology. However, there are still one more issues to be discussed. This trend tends to be connected to research on the factors that can result in positive effects, and the concept of 'resilience' that appears in the area of tinnitus research. It means psychological resilience from stress or pain. Research revealed that emotional stability and extraversion were correlated with resilience [38], and resilience was linked to psychobiological mechanisms that help keep (or maintain?) the HPA axis and noradrenergic system [39]. In a previous study, high resilience was associated with emotional health, depression, anxiety, and somatic symptoms of tinnitus [40].

In summary, tinnitus and the severity of tinnitus or its pain are associated with resilience, neuroticism, emotional instability, negative affectivity, social inhibition, or Type D personality. These factors are relatively stable and are long-lasting characteristics of personality, as well as having neurobiological mechanisms including the limbic system. The causal relation though is not clear because there is very little longitudinal research. In other words, it is clear that those personality factors can be obstacles to coping and adaptation after developing tinnitus, but it is not clear that those factors can directly affect the onset of tinnitus.

STRESS AND COPING MECHANISM IN TINNITUS

It is known that stress is related to the HPA axis or autonomous nervous system as well as resilience mentioned earlier. Especially in terms of tinnitus, stress can be a trigger to develop tinnitus, and its onset or pain can be a huge stressor. Tinnitus sufferers reported a greater amount of subjective strain at each stress phase compared to those in control group [4], and hearing problems were also more prevalent among those with more symptoms of long-lasting stress compared to those with less symptoms [41]. If the tinnitus persists, patients tend to exhaust their coping resources and experience negative emotions [22]. Stress is supposed to play a role as a trigger for hearing problem and the onset of tinnitus [42], and the symptoms of tinnitus themselves might cause higher physiological arousal and psychological distress. Maladaptive stress reactivity in chronic tinnitus patients should lead to hyper-reactivity in the autonomous nervous system [4].

However, the relation between stress and tinnitus is still under debate [22] since the concept of stress is vague and comprehensive. Also, the previous findings of tinnitus and stress were unclear because it was not definite which part or feature of stress was involved. Nevertheless, several meaningful implications can be found from

the review of previous research on stress in terms of related personality factors, cognition related to stress events, and coping strategies.

First, the personality factors vulnerable to stress events such as tinnitus were studied. The typical factor is fear avoidance. According to previous research, the factor of fear avoidance was found to show considerably low correlation with Big Five personality factors and significant association with distress related to tinnitus [43]. It means that fear avoidance is not explained by existing factors of personality but related to tinnitus. In psychology, fear avoidance or harm avoidance is referred to as temperament, which is considered as having hereditary and biological origin in addition to a constant personality factor. Thus, temperament is usually congenital and it can make response to stimulant without a mediation of learning [44]. While the causal relation or the order of the incident between the personality factors described previously and tinnitus is not clear, temperament is considered as a preceding factor in the relation with tinnitus, which can possess an advantage of having simplicity of the explanation. Fear or harm avoidance means a tendency that behavior is inhibited when a dangerous or disgusting stimulus is given, and it is related to a cautious, nervous, and safety-conscious propensity [44]. However, fear-avoidance has not been considered much in chronic pain research [45]. Few research on that showed a significant association with tinnitus severity [46].

In addition to the factor of temperament vulnerable to threat or stress, it was proposed that the effects of tinnitus could be affected by how an individual would think about a negative event itself. It was greatly influenced by the stress appraisal theory or cognitive personality theory. In these perspectives, a stable or long-lasting personality factor is not discussed, but a cognition of an issue is considered as important in later behavior. These theories have been widely supported in research of psychology, and in particular, it was confirmed that cognition of an event bringing about anxiety or distress played an important role in adaptation, coping, and prognosis afterward.

These perspectives were already proposed in tinnitus research. A study using a cognitive-behavioral model of fear-avoidance in patients with chronic pain implies an catastrophic cognitions about pain and its consequences, belief about the relation between specific activities and an increased risk of pain deterioration, and pain-related fear that motivates very specific avoidance behavior patterns [43,45]. Some previous research found the negative effects of catastrophic thinking about tinnitus or its disturbance. For example, a maladaptive coping style for tinnitus-including catastrophic

thinking about the consequences of tinnitus and avoidance behavior was significantly correlated with tinnitus severity, anxiety, and depressive symptoms [47].

Event-related cognition is likely to be affected by personality, but it is not considered the same as personality. People who tend to avoid danger are more likely to develop cognition of thinking catastrophically about threatening events. However, environmental or exogenous events can affect to develop cognition. In this sense, event-related cognition can be helpful to predict an individual's behavior afterward or some negative effects or prognosis rather than to explore the causes such as personality.

CONCLUSION

A summary of the results from research discussed above is as follows.

1. Chronic tinnitus causes psychological distress similar to distress caused by chronic physical illnesses.
2. Psychiatric disorders having comorbidity with tinnitus were depressive disorder, anxiety disorder, and sleep disturbance. The rates of comorbidity with these psychiatric disorders were not higher than those with chronic physical illnesses, but when only decompensated type of tinnitus, that is, complex tinnitus was included in the studies, the rates of comorbidity increased significantly. Comorbid psychiatric disorders seem to aggravate tinnitus severity, tinnitus related disturbance and dysfunction.
3. There are neurobiological mechanisms that are common in tinnitus and affective disorders or mood dysregulation: Limbic system and HPA axis or noradrenergic system. The common neurobiological mechanism implies the possibility that congenital vulnerability can affect the onset of tinnitus and mental disorders. However, it is still possible that distress caused by tinnitus can cause mental disorders.
4. Early studies exploring personality factors related to tinnitus did not make clear whether the factors reflected either personality, or mental disorders. Later studies showed that neuroticism, emotional instability, social inhibition or social insensitiveness, or type D personality were related to whether tinnitus existed or not, the severity of symptoms, or distress due to tinnitus. However, it is not enough to conclude the causal relation or the order of the incident based on the association between those personality factors and tinnitus be-

cause there are few longitudinal studies.

5. Stress can be a trigger to develop tinnitus, and stress of tinnitus can cause negative effects later. However, it is still not clear which features of stress are involved in reaction to tinnitus.
6. There is a possibility to negatively cope with tinnitus because of fear avoidance or harm avoidance among the factors reflecting the characteristics of an individual's temperament and heredity. However, it is hard to find empirical studies directly supporting this possibility.
7. Fear-related cognition such as catastrophic thought about tinnitus affected the severity of the symptom or emotional distress. Cognition of an event can be affected by an individual's stable personality as well as an individual's situation. It can make an obstacle to do research on the origin of personality but take a relative advantage to predict future behaviors of tinnitus and results caused by tinnitus.

FUTURE DIRECTION

Research examining the influence of personality factors on tinnitus have made progress, but there are still more areas to be explored as well as methodological issues to be solved. Some suggestions for the topics in the future studies are as follows.

1. In order to confirm the effects of personality, longitudinal research is needed to find the causal relation. If both personality and psychiatric problems and the factors related to tinnitus are measured at the same time, the causal relation is not definite.
2. If longitudinal research is not available, more attention is required in terms of selecting assessment tools to measure the factors of personality. It is required to find out that the tool measuring psychological construct is mainly affected by a current state or by a stable personality, and it is crucial to use assessment tools in accord with the objectives of research and analyze the results.
3. More elaborate statistical analyses should be performed. As described above, the measures of chronic trait-factors and state-factors at a certain point are highly correlated. After moving out covariance which is a redundant pair of the measures, it is needed to examine whether the remaining part is associated with tinnitus. In addition, previous research found that demographic factors including gender affected tinnitus [48]. The effects of personality should be confirmed after the effects of

gender, socioeconomic status, or social network are removed, and it is needed to look into whether there are interactive effects between personality and demographic factors or not.

4. Research should be conducted based on the types of tinnitus. The percentages of tinnitus were not different from those of physical illnesses in terms of comorbidity, but the differences were clear when the types of tinnitus were divided to decompensated and compensated. Thus, there is a possibility that in some previous research, the association between personality and tinnitus were not significant because the tinnitus types were not divided.
5. Along with the recent research trend, the effects of focused and narrow-defined psychological construct, other than general and complex construct, should be explored. It is necessary to investigate tinnitus-related cognition, catastrophic thinking, or avoidance behavior related to pain due to tinnitus, adaptation to illnesses, decline of social function, and quality of life.
6. In previous research, people who accept their condition—that is, suffering from tinnitus—showed higher levels of quality of life [49]. Cognitive behavior therapy (CBT), including relaxation training, concentration control training or acceptance, was effective in mitigating pains due to tinnitus [50]. It implies that psychological therapeutic interventions can be effective besides medication. It is necessary to continuously examine the effects of psychological therapy such as CBT or acceptance therapy in future research.

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