



## Insomnia in patients with chronic tinnitus: Cognitive and emotional distress as moderator variables



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### ABSTRACT

**Introduction:** Tinnitus is often associated with disturbed sleep, but there are also patients without sleep problems. The mechanisms for developing insomnia or not in tinnitus patients are still unknown. The aim of the present study was to extract possible tinnitus specific factors that increase the risk of developing insomnia based on the analysis of a large patient cohort suffering from chronic tinnitus.

**Method:** 173 patients presenting at the multidisciplinary tinnitus center of a University Hospital completed a questionnaire measuring specific psychological symptoms of insomnia (RIS) and a tinnitus questionnaire (TQ). The scores of all ten RIS items were compared between tinnitus patients and 94 healthy individuals by separate ANOVAs in order to specify the extent of insomnia specific symptoms in the tinnitus group. In a second step a multiple linear regression analysis was performed in the tinnitus sample with subscales of the TQ (excluding the TQ sleep scale), age and duration of tinnitus as independent variables and the RIS score as the dependent variables.

**Results:** Tinnitus patients differed from healthy controls not only in impaired sleep quality but also in insomnia specific concerns and anxiety. Tinnitus related emotional and cognitive distress and somatic complaints correlated with severity of insomnia, whereas no association of age or duration of tinnitus with severity of insomnia was found. **Conclusion:** Our results suggest that chronic tinnitus patients have more sleeping difficulties and associated worries about sleep or negative emotions in contrast to healthy controls. Tinnitus-related distress is related to insomnia

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### Introduction

“Sleep problems are a frequent complaint in patients with tinnitus [1–4] with a prevalence of up to 77% [5,6] and an association with self-rated tinnitus severity [5,7]. However, beyond the evidence for the association of tinnitus and disturbed sleep, little is known about the mechanisms and the modulating factors that contribute to the development of insomnia in tinnitus patients. This is of great interest, since about 50% of the persons affected by tinnitus do not develop sleep problems [3,6]. These data support the assumption that sleep problems in tinnitus patients are not merely a consequence of the physical sensation of the disturbing sound, but that there are other factors contributing to the mechanisms for impairment of sleep quality. These factors could be psychological and cognitive variables. However, these symptoms in association with disturbed sleep had not attracted much attention in tinnitus research so far.

This becomes apparent when looking at the measurements used to quantify sleep problems. Most studies relied on sleep items derived from tinnitus questionnaires [5,8–10] and only a few studies applied

insomnia specific instruments [2,11,12] that included psychological and cognitive variables. Thus, despite an accumulated amount of data about disturbed sleep in tinnitus patients, it is not clear whether tinnitus patients with sleep problems suffer solely from disturbed sleep or also from insomnia specific symptoms such as sleep related worries. This would shed some light on the possibility of whether disturbed sleep in tinnitus patients is caused by a complex interaction of insomnia disorders and tinnitus.”

Knowledge about psychological or other factors triggering the development of insomnia in tinnitus patients is important both for the development of an adequate therapy as well as for a more detailed understanding of the pathophysiological underpinnings of chronic tinnitus. A recently published review hypothesized a pathophysiological overlap for tinnitus and insomnia [4] namely a hyperarousal. Hyperarousal could be defined as a chronically enhanced internal stress level. There is evidence that in tinnitus patients emotional distress is the strongest mediator of tinnitus handicap [13–15].

In addition the relationship of insomnia and tinnitus has recently been brought into the sharper focus of research since similar modules of behavior therapy seem to be efficient for both disorders [16].

In order to elucidate the relationship between insomnia and tinnitus we retrospectively gathered information from an insomnia specific sleep questionnaire and a tinnitus questionnaire in a large sample of

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patients showing chronic tinnitus. The aim was to identify insomnia specific symptoms among tinnitus patients. Our hypothesis was that tinnitus patients with disturbed sleep also exhibit other insomnia specific symptoms. Moreover we aimed to investigate which insomnia symptoms were associated with severity of tinnitus. In order to make the difference between insomnia and disturbed sleep clear we point out here that throughout this manuscript we will use the term insomnia for the description of the clearly defined sleep disorder insomnia.

## Methods

### Sample

All participating tinnitus patients presented at the multidisciplinary Tinnitus Clinic for inpatients and outpatients at the University of Regensburg (Regensburg, Germany) between 2006 and 2014. Patients gave written informed consent for data collection in the Tinnitus Research Initiative Database [17] which was approved by the Ethics Committee of the University Hospital of Regensburg (Germany; reference number 08/046). Inclusion criteria were subjective chronic tinnitus. Exclusion criteria were objective tinnitus (with a treatable cause) and presence of unstable psychiatric comorbidities (such as psychosis, dementia, severe mood disorders or addiction) or other unstable medical conditions.

From an original study sample [18] consisting of 258 patients 85 individuals were excluded due to incomplete data (at least one missing item in any questionnaire).

Participant characteristics: The final sample consisted of 51 women (mean age:  $51.0 \pm 12.6$  years) and 122 men (mean age  $54.5 \pm 10.9$  years). Mean duration of tinnitus was 94 months  $\pm$  94 months. 15 patients experienced their tinnitus only on the right side, 31 on the left side, 103 in both ears and 18 in their head (in 6 patients no information regarding tinnitus laterality available).

Data of healthy controls derived from the validation sample of the RIS questionnaire [19] were used as a reference group: 94 persons including 45 men (mean age:  $50.1 \pm 13.1$  years) and 49 women (mean age:  $43.7 \pm 12.0$  years).

### Measurements

Patients filled in the German version of the Tinnitus Questionnaire (TQ) [20,21] with 52 items. The TQ total score results from the summation of 44 items with 2 items counted double. It contains different subscales indicating emotional and cognitive distress, sleep disturbance, auditory perceptual difficulties, somatic complaints and intrusiveness. Cronbach alpha indicating internal consistency was .945 and therefore in a very good range.

The Regensburg Insomnia Scale (RIS) was developed to measure the specific psychological symptoms and sleep parameters of insomnia. It contains ten items exploring sleep quantity and quality, sleep-related anxiety and worries, hypnotic intake and daytime fitness [19] with a score range of 0 to 40 points (cut-off for insomnia:  $>12$ ). Cronbach alpha was .899.

### Statistics

ANOVAs were calculated for each item of the RIS with study groups as a factor. As the control sample was significantly younger than the tinnitus sample ( $t = -4.327$ ;  $p < .0005$ ) and gender was also not evenly distributed in the two samples ( $\text{Chi}^2 = 13.336$ ;  $p < .0005$ ), both variables were added as covariates in all ANOVAs. In order to exclude blurring effects of age and gender, all ANOVAs were also calculated without covariates. For the correction of multiple testing, Bonferroni corrections were performed. All significance levels were corrected for the number of tests, in this case 10.

Multiple linear regression analysis was calculated with age and duration of tinnitus and four subscales of the TQ as independent variables (“emotional and cognitive distress score”, “intrusiveness score”, “auditory perceptual difficulties score” and “somatic disturbance items”) and the RIS score as the dependent variable for tinnitus patients. The sleep subscale of the TQ was not included in the analysis.

IBM SPSS Statistics, Version 22 was used.

## Results

27% of the tinnitus patients had a normal score in the insomnia scale.

Table 1 shows means and standard deviations of RIS items of healthy controls in comparison to all tinnitus patients and the results of ANOVAs for each RIS item (study groups as factors). In all RIS items except for “easy awakening” there were differences between the tinnitus group and the control group. These results remained also when ANOVAs were calculated without sex and gender as covariates.

Linear regression analysis showed a significant model ( $F = 11.190$ ;  $p < .0005$ ) as well as significant effects for subscale emotional and cognitive distress and somatic complaints. R squared was .302, indicating that 30% of the variance could be explained by the model.

No effect on the severity of insomnia was seen for age or duration of tinnitus (see Table 2).

## Discussion

Our results demonstrate that the tinnitus patients in the investigated sample did not only have a more disturbed sleep than controls, but also reported more insomnia-specific psychological symptoms. Moreover among tinnitus-specific symptoms emotional and cognitive distress as well as somatic complaints seem to be related to the severity of insomnia. A further result is that not all tinnitus patients showed insomnia symptoms. In 27% of all investigated tinnitus patients the score in the insomnia questionnaire was within the normal range.

All findings support the hypothesis that in some patients with tinnitus disturbed sleep is not only a reaction to the disturbing tinnitus, but is also associated with other insomnia specific symptoms. If sleep difficulties were solely the consequence of the disturbing tinnitus sound, one would expect that tinnitus patients differed only in parameters that refer to sleep quality, such as sleep onset or sleep continuity. On the contrary tinnitus patients did not only differ in sleep parameters but also in psychological insomnia specific symptoms such as enhanced worrying about sleep, anxiety concerning the process of falling asleep and the experiences of sleepless nights. It is possible that disturbed sleep may trigger additional psychological symptoms such as sleep related worries and enhanced anxiety. This tendency of catastrophizing thoughts and anxious rumination in interaction with the experience of problems falling asleep may function as a mediator of the relationship between insomnia and experienced tinnitus.

The association between insomnia and tinnitus may reflect an overlap in the pathophysiological mechanisms [4].

The association of emotional and cognitive distress in tinnitus patients with insomnia is apparent in the results of our second analysis. Here we analyzed whether different tinnitus-specific features, age or duration of tinnitus are associated with the severity of insomnia. The analysis revealed a significant association between emotional and cognitive distress related to the tinnitus and insomnia severity as measured with the RIS. The subscale emotional and cognitive distress in the TQ refers to cognitions that reflect a helpless and resigned attitude towards tinnitus sounds (“I am wondering often, whether this sound will ever go away” or “My life is going to be worthless, if this sound will not pass”). It is likely that cognitions like these ruminate together with the tinnitus sound in quiet moments (for example when lying in bed) preventing or impairing the process of falling asleep. The association between dysfunctional cognitions such as catastrophic worrying and an impaired process of falling asleep is well examined in patients with

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