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Factors related to insomnia in adult patients with tinnitus and/or hyperacusis: An exploratory analysis

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Short title

Insomnia in patients with tinnitus

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Abstract

Background: People with tinnitus and/or hyperacusis often experience insomnia. However, it is unclear what factors are most strongly associated with insomnia.

Purpose: To explore factors related to insomnia in patients with tinnitus and/or hyperacusis.

Research Design: This was a retrospective study using multiple-regression analysis.

Study Sample: Data were assessed for 444 consecutive patients who sought help concerning their tinnitus and/or hyperacusis from a specialist audiology center in the UK National Health Service. The average age of the patients was 54 years (SD = 15 years).

Data Collection and Analysis: The results of audiological tests and self-report questionnaires were gathered retrospectively from the records of the patients. Multiple-regression analysis was used to assess the relationship between insomnia and other variables.

Results: 69% of patients with tinnitus experienced some form of insomnia as measured via the Insomnia Severity Index (ISI). A multiple-regression model showed that ISI scores were significantly associated with depression scores measured via the depression subscale of the Hospital Anxiety and Depression Scale (HADS) (regression coefficient (b) = 0.44, p<0.001), tinnitus annoyance measured via the visual analog scale (VAS) (b = 0.49, p = 0.001), anxiety measured via the anxiety subscale of the HADS (b = 0.21, p = 0.012) and tinnitus handicap measured via the Tinnitus Handicap Inventory (b = 0.07, p<0.001). The model explained 45% of the variance in ISI scores. VAS scores for tinnitus loudness, hyperacusis-related measures, hearing thresholds, age and gender were not significantly related to insomnia.

Conclusions: The prevalence of insomnia in patients with tinnitus is high. Both tinnitus-related factors and psychological factors are related to the severity of insomnia. Hyperacusis is not significantly associated with insomnia.

Key words: insomnia, tinnitus, hyperacusis, depression, anxiety

Abbreviations: BDI-II = Beck Depression Inventory II; HADS = Hospital Anxiety and Depression Scale; HQ = Hyperacusis Questionnaire; ISI = Insomnia Severity Index; OR = odds ratio; PSQI = Pittsburgh Sleep Quality Index; RIS = Regensburg Insomnia Scale; SAS = Self-rating Anxiety Scale; SD = standard deviation; SDS = Self-rating Depression Scale; THI = Tinnitus Handicap Inventory; TQ = Tinnitus Questionnaire; TRQ = Tinnitus Reaction Questionnaire; TSI = Tinnitus Severity Index; ULL = Uncomfortable Loudness Level; ULLmin = average ULL at 0.25, 0.5, 1, 2, 4 and 8 kHz for the ear with the lower average ULL;VAS = visual analog scale

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INTRODUCTION

Tinnitus is the sensation of sound without any external acoustic sound source. Hyperacusis is a term used to describe intolerance to everyday sounds that causes significant distress and impairment in social, occupational, recreational, and other day-to-day activities (Aazh et al. 2016). Tinnitus and hyperacusis commonly occur together: approximately 90% of patients with a primary complaint of hyperacusis experience tinnitus, and 40% of those with a primary complaint of tinnitus experience hyperacusis (Baguley 2018).

Tinnitus is also commonly associated with insomnia. Tyler and Baker (1983) reported that 57% of patients who were members of a tinnitus support group (n = 97) reported having problems getting to sleep because of their tinnitus. Meikle et al. (1984) reported that for patients experiencing tinnitus (n = 1219), the incidence of sleep disturbances increased as the self-reported tinnitus severity increased. Folmer and Griest (2000) reported that the severity of tinnitus as measured via the Tinnitus Severity Index (TSI) (Meikle et al. 1984) and via self-reported tinnitus loudness on a 1 to 10 scale was associated with the severity of sleep disturbances as measured via a single question asking whether tinnitus interfered with sleep. Miguel et al. (2014) reported that scores on the Tinnitus Reaction Questionnaire (TRQ) (Wilson et al. 1991) were correlated ($r = 0.62$) with scores on the Insomnia Severity Index (ISI; Bastien et al. 2001) (n=117). Scheckl mann et al. (2015) analysed data for 182 patients with chronic tinnitus and found that scores on the Tinnitus Questionnaire (TQ) (Hallam et al. 1988) were correlated ($r = 0.558$) with scores on the Regensburg Insomnia Scale (RIS) (Cronlein et al. 2013). Cronlein et al. (2016) used a regression analysis and reported that the somatic complaints subscale of the TQ (the subscale concerned with the presence of ear pain and muscle tension) and the emotional distress subscale of the TQ significantly predicted the severity of insomnia measured via the RIS (n = 173). However, their model predicted only 30% of the variance in RIS scores. Recent studies suggest that over 70% of patients seeking help for tinnitus and/or hyperacusis present with symptoms of insomnia (Aazh et al. 2016; Schecklmann et al. 2015).

The factors leading to insomnia for people with tinnitus remain somewhat unclear. From the clinical experience of the first author, a common concern expressed by patients is that although they can cope with the current loudness of their tinnitus, one of their fears is that if their tinnitus gets louder it may stop them sleeping at nights, leading to a constant state of fatigue that they would not be able to cope with. Andersson and Edvinsson (2008) pointed

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out that fear of the consequences of tinnitus is one of the main features of tinnitus sufferers. In the studies described above, the possible role of anxiety and depression was not taken into account.

Xu et al. (2016) conducted regression analyses to assess whether, for patients with tinnitus (n = 543), sleep disturbances measured via the Pittsburgh Sleep Quality Index (PSQI) (Buysse et al. 1989) were related to anxiety and depression measured via the Self-rating Anxiety Scale (SAS) (Zung 1971) and the Self-rating Depression Scale (SDS) (Zung 1974). They reported significant associations between two measures of sleep problems, the time needed to get to sleep and day time dysfunction, and SAS and SDS scores. However, other aspects of sleep measured via the PSQI, such as habitual sleep efficiency, sleep disturbances, subjective sleep quality, sleep duration, and use of sleep medication, were not significantly associated with SAS and SDS scores. Xu et al. (2016) did not include tinnitus-related measures in their model.

The models created by Cronlein et al. (2016) and Xu et al. (2016) did not take into account possible intervening factors. Doing so can markedly change regression coefficients (Kutner et al. 2004). Therefore, it is important to adjust any regression model to take into account the possible influence of other variables. Aazh et al. (2017) assessed factors related to insomnia measured via the insomnia severity index (ISI; Bastien et al. 2001) among older patients with tinnitus and/or hyperacusis (n = 151). They included scores for the Tinnitus Handicap Inventory (THI) (Newman et al. 1996) and the Hospital Anxiety and Depression Scale (HADS; Zigmond & Snaith 1983) in their regression model. They found that higher scores on the ISI were associated with higher (worse) scores on the depression subscale of the HADS ($p = 0.007$). ISI scores were not significantly predicted by scores for the anxiety subscale of the HADS or by THI scores. However, their model explained only 32% of the variance in the ISI scores. Also, as insomnia is prevalent among older people whether or not they have tinnitus (Foley et al. 1995), it is not clear whether the model would be applicable to younger people.

The relationship between insomnia and hyperacusis is unclear. Hebert and Carrier (2007) assessed whether PSQI scores were related to tinnitus distress measured via the TRQ, hyperacusis handicap measured via the hyperacusis questionnaire (HQ) (Khalfa et al. 2002) and depression measured via the Beck Depression Inventory II (BDI-II) (Steer et al. 1997). They included 51 patients with tinnitus and 51 patients with no tinnitus. PSQI scores were associated with HQ and BDI-II scores, but not with average hearing thresholds or TRQ scores for the group of patients with tinnitus. Their regression model explained 43% of the

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variance in PSQI scores. However, their sample had a mean age of 68 years. As mentioned previously, insomnia is prevalent among older people, so it is not clear whether the relationship found between insomnia and hyperacusis would occur for younger people.

Fioretti et al. (2013) reported that among 37 consecutive patients with tinnitus, 30% reported having both hyperacusis and sleep disorders. The presence of hyperacusis and sleep disorders was diagnosed based on patients' answers to the questions "Do you have a problem tolerating sounds because they often seem much too loud?" and "Do you have difficulty falling asleep, waking in the night or too early in the morning?". They did not assess whether sleep disorders were more prevalent among patients with hyperacusis than among those with tinnitus only. Nordin and Nordin (2016) reported that 313/8520 people sampled from general population answered yes to the question "Do you have a hard time tolerating everyday sounds that you believe most other people can tolerate?" The incidence of sleep disturbances measured using the DSM-IV diagnostic criteria (American Psychiatric Association 2000) for insomnia was significantly higher for this group than for those who answered no to the question. Baliatsas et al. (2016) reported that for people from the general population who selected "strongly agree" on a 5-point scale from "strongly agree" to "strongly disagree" for the statement "I am sensitive to noise" (n = 722/5806), the odds ratio (OR) of sleep problems as measured via the Sleep Quality Scale (Visser et al. 1978) was 1.94 (95% confidence interval: 1.63-2.32) relative to those who chose options other than "strongly agree". Park et al. (2017) assessed noise sensitivity for a sample of the general population (n = 1836) via a single question with responses on an 11-point Likert scale: 0 indicated the lowest sensitivity and 10 indicated the highest sensitivity. They reported that the OR of insomnia, assessed using the ISI, was 2.05 for individuals with high noise sensitivity (scores 6-10) relative to those with low noise sensitivity (scores 0-5). They also reported that the OR of an abnormal score on the ISI was 2.08 after taking into account the effects of age, gender, income and general health. However, they did not include measures of anxiety, depression or tinnitus in their model. Thus, the influence of hyperacusis *per se* on insomnia remains unclear.

Given the high prevalence of insomnia among patients with tinnitus and/or hyperacusis, and the impact of insomnia on the general quality of life (Lasisi & Gureje 2011), it is important to explore the factors that contribute to insomnia among patients with tinnitus and/or hyperacusis. The aim of this study was to explore factors associated with insomnia for patients who sought help with regard to their tinnitus and/or hyperacusis from an audiology clinic in the UK National Health Service.

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METHOD

Study Design and Patients

This was a retrospective study conducted at the Tinnitus and Hyperacusis Therapy Specialist Clinic, Royal Surrey County Hospital, Guildford, UK. Data were included for 444 consecutive patients who attended the clinic from January 2013 to January 2016 and who completed self-report questionnaires and audiological examinations. The average age of the patients was 54 years (SD = 15 years). Forty nine percent were male.

Audiological Investigations

Pure tone audiograms were measured using the procedure recommended by the British Society of Audiology (BSA 2011a). The severity of hearing loss was categorized based on the values of the pure-tone average over the frequencies 0.25, 0.5, 1, 2, and 4 kHz, as recommended by the British Society of Audiology (BSA 2011a): Mild (20 – 40 dB HL), Moderate (41 – 70 dB HL), Severe (71 – 95 dB HL) and Profound (over 95 dB HL). Uncomfortable Loudness Levels (ULLs) were measured following the BSA recommended procedure (BSA 2011b). When the average ULL at 0.25, 0.5, 1, 2, 4 and 8 kHz for the ear with the lower average ULL, which is called ULLmin, was ≤77 dB HL, hyperacusis was deemed to be present (Aazh & Moore 2017). The criterion for diagnosing severe hyperacusis was taken as a ULL of 30 dB HL or less for at least one of the measured frequencies, 0.25, 0.5, 1, 2, 3, 4, 6, and 8 kHz, for at least one ear (Aazh & Moore 2018a).

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Assessment of Insomnia

Insomnia was assessed using the ISI, which comprises seven items that assess the severity of sleep difficulties and their effect on the patient’s life. Each item is rated on a scale from 0 to 4 and the total score ranges from 0 to 28. Scores from 0-7 indicate no clinically significant insomnia, scores from 8-14 indicate slight insomnia, scores from 15-21 indicate moderate insomnia, and scores from 22-28 indicate severe insomnia (Bastien et al. 2001).

Assessment of Tinnitus and Hyperacusis Handicap

Tinnitus handicap was assessed using the THI, which has 25 items. The response choices are "no" (0 points), "sometimes" (2 points) and "yes" (4 points). The overall score ranges from 0 to 100. Scores from 0–16 indicate no handicap, scores from 18–36 indicate mild handicap, scores from 38–56 indicate moderate handicap, and scores from 58–100

indicate severe handicap (Newman et al. 1996).

Hyperacusis handicap was assessed using the HQ, which comprises 14 items. The response choices are "no" (0 points), "yes, a little" (1 point), "yes, quite a lot" (2 points), and "yes, a lot" (3 points). The overall score ranges from 0 to 42. Scores above 22 were taken as indicating hyperacusis handicap (Aazh & Moore 2017).

Self-reported Tinnitus Loudness, Annoyance and Effect on Life

The VAS was used to assess the self-reported loudness and annoyance of tinnitus and the effect of tinnitus on the patient's life. VAS scores are ratings on a scale from 0 to 10. The VAS score for the loudness of tinnitus was assessed by asking the patient to rate the loudness of tinnitus during their waking hours over the last month (It was explained that 0 corresponds to no tinnitus being heard and 10 is the loudest that they can imagine). The VAS score for annoyance induced by the tinnitus was assessed by asking the patient to rate their subjective perception of annoyance on average during the last month (It was explained that 0 corresponds to no annoyance and 10 is the most annoying thing that can possibly happen). The VAS score for the impact of tinnitus on their life was assessed by asking the patient to rate the effect of tinnitus on their life during the last month (It was explained that 0 corresponds to no effect and 10 is an extreme effect).

Assessment of Anxiety and Depression

Anxiety and depression were evaluated using the HADS, which consists of 14 items, each rated from 0 to 3 according to the severity experienced. Eight items require reversed scoring, after which anxiety (HADS-A) and depression (HADS-D) subscale totals can be obtained. The total score for each subscale ranges from 0 to 21. Scores from 0-7 are classified as normal, scores from 8-10 are classified as borderline abnormal and scores from 11-21 are classified as abnormal (Zigmond & Snaith 1983).

Ethical Approval

This study was approved by the South West-Cornwall and Plymouth Research Ethics Committee.

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Data Analysis

The data were anonymised prior to statistical analysis. Descriptive statistics (means and SDs) for the characteristics of the patients, audiological assessments and scores for the self-report questionnaires were calculated. The scores were all approximately normally distributed. Pearson correlation tests and χ^2 tests were used to assess the relationships between different measures and *t*-tests were used to assess mean differences. The *p*-value required for statistical significance was set at $p<0.05$. The variables that had significant correlations with ISI scores were included in a regression model to examine whether the variables significantly influenced the ISI score. A stepwise linear multiple regression model was created to predict the ISI score, beginning with a full model that included all variables. Then, variables were removed to assess whether their inclusion significantly affected the goodness of fit. The STATA program (version 13) was used for statistical analyses.

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RESULTS

The mean scores and SDs for the ISI, HADS, THI, VAS and HQ are shown in Table 1. Based on scores for the ISI, 31% (137) of patients did not have insomnia, 30% (131) had mild insomnia, 28% (122) had moderate insomnia, and 12% (54/444) had severe insomnia. Based on scores for the THI, 12% of patients (52) had no tinnitus handicap, 32% (141) had a mild tinnitus handicap, 24% (105) had a moderate tinnitus handicap, and 33% (146) had a severe tinnitus handicap. For the anxiety subscale of the HADS, 41% (181) of patients had normal scores, 23% (102) had borderline abnormal scores, and 36% (161) had abnormal scores. For the depression subscale of the HADS, 68% (301) of patients had normal scores, 14% (63) had borderline abnormal scores, and 18% (80) had abnormal scores. Based on scores for the HQ, 32% (141) of patients had hyperacusis.

The means and SDs of the hearing thresholds and ULLs for each ear and each frequency are shown in Table 2. The mean pure-tone average across the frequencies 0.25, 0.5, 1, 2, and 4 kHz and across ears was 20 dB HL (SD = 13 dB). The mean of the average ULL across 0.25, 0.5, 1, 2, 4 and 8 kHz and across ears was 83 dB HL (SD = 14 dB). Based on the pure-tone average for the better ear, 66% (293) of patients had no hearing loss, 29% (128) had mild hearing loss, and 5% (23) had moderate hearing loss. Based on the pure-tone average for the worse ear, 49% of patients (217) had no hearing loss, 37% (163) had mild hearing loss, 13% (58) had moderate hearing loss, 0.7% (3) had severe hearing loss, and 0.7% (3) had profound hearing loss.

Based on the values of ULLmin, 30% (133) of patients had ULLs ≤77 dB HL, indicating hyperacusis. Four percent (18) of patients were diagnosed with severe hyperacusis, as indicated by ULLs ≤30 dB for at least one of the measured frequencies in at least one ear.

TABLES 1 & 2 HERE

Relation between Insomnia and Tinnitus

There was a significant association between THI category and ISI category; χ^2 (9) = 137, p<0.001. Patients in the moderate and severe tinnitus handicap categories were more likely to have moderate or severe insomnia.

Relation Between Insomnia and Anxiety and Depression

There was a significant association between HADS anxiety category and ISI category; χ^2(6) = 107, p<0.001. Patients with abnormal anxiety were more likely to have moderate and severe insomnia.

There was a significant association between HADS depression category and ISI category; χ^2(6) = 125, p<0.001. Patients with abnormal depression were more likely to have severe insomnia.

Insomnia and Hyperacusis

The mean ISI score was 14.2 (SD = 7.3) for patients with tinnitus combined with hyperacusis (diagnosed based on ULLmin values) compared to 11.5 (SD = 7.1) for patients with tinnitus only, and the difference was significant (p = 0.0003). The mean ISI score was 15.5 (SD = 7.1) for patients with tinnitus combined with hyperacusis (diagnosed based on HQ scores) compared to 10.9 (SD = 6.8) for patients with tinnitus only, and the difference was significant (p<0.001). The mean ISI score was 15.3 (SD = 6.9) for patients with tinnitus combined with severe hyperacusis (diagnosed based on ULL values) compared to 12.2 (SD = 7.2) for patients with tinnitus without severe hyperacusis. However, this difference was not significant (p = 0.078). Overall, these results indicate that sleep problems tend to be worse for patients with tinnitus combined with hyperacusis than for patients with tinnitus only.

Factors Related to Insomnia

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There were significant correlations between ISI scores and the following variables: THI scores (r = 0.58, p<0.001), VAS scores for tinnitus annoyance (r = 0.47, p<0.001), VAS scores for tinnitus loudness (r = 0.36, p<0.001), VAS scores for effect of tinnitus on life (r = 0.45, p<0.001), HADS anxiety and depression scores (r = 0.53 and r = 0.57, respectively, both p<0.001), HQ scores (r = 0.39, p<0.001), and ULLmin values (r = –0.18, p = 0.0001). There were no significant correlations between ISI scores and the pure tone average for the better ears (r = 0.04, p = 0.4) or the worse ears (r = –0.005, p = 0.91), and age (r = –0.01, p = 0.8). There was no significant difference in ISI scores between males and females (p = 0.83).

All variables that were significantly correlated with ISI scores were included in a stepwise linear-regression model. The following variables did not significantly contribute to the prediction of ISI scores: VAS for tinnitus loudness (p = 0.87), VAS for effect of tinnitus on life (p = 0.77), HQ score (p = 0.62), and ULLmin (p = 0.057). These variables were eliminated from the model. As shown in Table 3, in the final model ISI scores were significantly associated with HADS depression scores, tinnitus annoyance as measured via the VAS, HADS anxiety scores, and THI scores. The model explained 45% of the variance in ISI scores.

TABLE 3 HERE

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DISCUSSION

Over two thirds of patients with tinnitus and/or hyperacusis who sought help from an audiology NHS clinic in the UK had insomnia as measured using the ISI. Although VAS scores for tinnitus loudness were significantly correlated with ISI scores, the VAS loudness scores did not significantly predict insomnia in the regression model. Rather, the model showed that insomnia was significantly related to tinnitus annoyance, depression and anxiety, and tinnitus handicap. The failure to find a significant effect of tinnitus loudness in the regression model may have occurred for two reasons: (1) the contribution of tinnitus loudness to variability in insomnia may be small compared to the contribution of other variables included in the model; (2) the relationship between tinnitus loudness and insomnia may be mediated via other variables, such as depression and anxiety and tinnitus annoyance (Aazh & Moore 2018b).

Several other researchers have reported a relationship between tinnitus loudness and sleep disturbance (Meikle et al. 1984; Folmer & Griest 2000). Folmer and Griest (2000) measured sleep disturbance with just one question: "Does your tinnitus interfere with sleep?". They reported that there was a significant difference in tinnitus loudness between a group of patients who often had trouble sleeping and groups who never or sometimes had sleep disturbance ($p<0.001$). Meikle et al. (1984) reported that there was a statistically significant relationship between the severity of tinnitus and the proportion of people reporting sleep disturbance caused by their tinnitus. These researchers did not assess whether the relationship between sleep disturbance and tinnitus remained significant after taking into account the effect of other relevant variables, such as depression. Their results are consistent with our results, since we also found a significant correlation between VAS scores for tinnitus loudness and ISI scores. However, our regression analysis suggested that the relationship is an indirect one rather than a causal one.

About 30% of our patients had hyperacusis based on ULLmin values and 32% had hyperacusis as measured via the HQ in addition to tinnitus. Unfortunately, it was not recorded whether tinnitus or hyperacusis was the primary complaint for each patient. ISI scores were significantly higher for patients with tinnitus combined with hyperacusis than for patients with tinnitus alone. This is consistent with the results of Nordin and Nordin (2016), as described in the Introduction, who reported a higher incidence of insomnia among the general population for those who self-reported sound tolerance problems. Our results also showed that HQ scores and ULLmin values were significantly correlated with ISI scores ($r = 0.39$, $p<0.001$) and ($r = -0.18$, $p<0.001$), respectively. This is consistent with the results of Hebert and Carrier (2007), who reported a significant relationship between HQ scores and sleep disturbances measured via the PSQI.

Taken together, these results appear to support an association between hyperacusis and insomnia. However, the step-wise linear regression model showed that the measures of hyperacusis (HQ scores and ULLmin scores) did not significantly predict insomnia. As for tinnitus loudness, this is consistent with hyperacusis having an indirect effect on insomnia, mediated via depression and anxiety. Future research should explore the processes by which tinnitus loudness and hyperacusis may lead indirectly to insomnia.

Our final model, which explained 45% of the variance in ISI scores, showed that ISI scores were significantly predicted by tinnitus annoyance, depression, anxiety, and tinnitus handicap. Contrary to our results, Hebert and Carrier (2007) reported that insomnia scores

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measured via the PSQI were associated with HQ and BDI-II scores, but not with tinnitus distress as measured via the TRQ. Their regression model explained 42.5% of the variance in PSQI scores. However, the two studies agree that depression is significantly associated with insomnia among patients with tinnitus. This is consistent with previous work showing a link between insomnia and depressive symptoms in patients with tinnitus (Cronlein et al. 2016; Aazh et al. 2017; Xu et al. 2016). Future studies should explore whether insomnia in people with tinnitus needs to be managed in conjunction with treatment for depression.

The discrepancy between our results and those of Hebert and Carrier (2007) with regard to the relationship between tinnitus-related measures and insomnia could be related to the following facts: (1) The sample size was smaller in their study (n = 51) than in ours (n= 444), making their study more vulnerable to type II errors; (2) Their study was focused on older adults with a mean age of 68 years (SD = 6.5 years), while our patients had a mean age of 54 years (SD = 15 years). Insomnia is highly prevalent among older people, and tinnitus may not markedly increase age-related sleep difficulties (Aazh et al. 2017); (3) Hebert and Carrier (2007) modified the TRQ by removing one item that specifically referred to sleep disturbances. We used the unmodified THI, which also includes one item assessing the impact of tinnitus on sleep.

Another discrepancy across studies is that Hebert and Carrier (2007) found a significant relationship between HQ scores and insomnia scores, despite controlling for depression and tinnitus-related measures, while we did not. This may also be due to the difference in study populations. Hyperacusis may have a greater influence on insomnia among older than among younger patients. Further research is needed to assess whether this is the case.

Four percent of the patients in our study were diagnosed with severe hyperacusis, diagnosed as suggested by Aazh and Moore (2018a) on the basis of ULLs ≤30 dB HL for at least one of the measured frequencies in at least one ear. Although the mean ISI was worse for patients with tinnitus combined with severe hyperacusis than for the remainder of the population, the difference was not significant. This could be due to the small number of patients who were diagnosed with severe hyperacusis, leading to a type II error. Future studies with larger sample sizes should explore whether severe hyperacusis is related to insomnia.

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CONCLUSIONS

For patients who sought help concerning tinnitus and/or hyperacusis in a UK National Health Service audiology clinic, a stepwise multiple-regression analysis showed that insomnia was significantly predicted by tinnitus annoyance, depression, anxiety and tinnitus handicap. Insomnia was not significantly predicted by VAS scores for tinnitus loudness and effect of tinnitus on life, scores for hyperacusis handicap, ULLmin values, the pure-tone average of the better and worse ears, age or gender.

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Table 1. Means and SDs of scores of the study population for the insomnia severity index (ISI), hospital anxiety and depression scale (HADS), tinnitus handicap inventory (THI), visual analogue scale (VAS), and hyperacusis questionnaire (HQ)

Questionnaire	Mean	SD
ISI (0-28)	12.3	7.2
HADS (Depression) (0-21)	6.0	4.6
HADS (Anxiety) (0-21)	8.8	4.7
THI (0-100)	45	24
VAS (Tinnitus loudness) (0-10)	6.0	2.0
VAS (Tinnitus Annoyance) (0-10)	6.2	2.5
VAS (Effect of Tinnitus on Life) (0-10)	5.1	2.8
HQ (0-42)	17.6	9.1

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Table 2. Means (SD) of hearing thresholds (HTs in dB HL) and ULLs for each ear of the study population.

	Frequency, kHz					
	0.25	0.5	1	2	4	8
HT Right	17 (14) n = 444	17 (14) n = 444	18 (16) n = 444	20 (18) n = 444	31 (22) n = 444	38 (27) n = 442
HT Left	16 (13) n = 444	17 (14) n = 444	17 (14) n = 444	20 (17) n = 444	32 (21) n = 444	39 (25) n = 443
ULL Right	83 (15) n = 443	84 (15) n = 443	85 (14) n = 443	83 (16) n = 443	85 (16) n = 438	81 (19) n = 435
ULL Left	83 (15) n = 442	84 (15) n = 442	84 (14) n = 443	84 (15) n = 443	85 (16) n = 441	82 (18) n = 437

Note: Not all patients were tested at all frequencies. The number of patients for each cell is indicated by n.

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Table 3. Results of the stepwise linear regression model to determine variables that predict ISI scores (n = 444).

	Coefficient	*p* value	95% Confidence Interval	
VAS for Tinnitus Annoyance	0.49	0.001	0.21	0.77
Depression subscale of HADS	0.44	<0.001	0.27	0.61
Anxiety subscale of HADS	0.21	0.012	0.045	0.37
Tinnitus Handicap Inventory	0.07	<0.001	0.037	0.10

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