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Research paper

Psychological mediators of chronic tinnitus: The critical role of depression

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ABSTRACT

Background: Maintenance of chronic tinnitus has been proposed to result from a vicious cycle of hypervigilance occurring when a phantom sound is associated with anxiety and limbic system overactivity. Depression, obsessive-compulsiveness, illness attitudes and coping strategies are known to impact tinnitus, but their relationship with the vicious cycle is unknown. As such, we aimed to identify psychological mediators of the vicious cycle. We also examined the relationship between coping strategies and any identified mediators to facilitate the translation of our research to treatment settings.

Methods: We comprehensively assessed a heterogeneous community sample of 81 people with chronic tinnitus who completed measures assessing their tinnitus and psychological wellbeing. Specifically, we examined the mediating role of depressive symptoms, illness attitudes, and obsessive-compulsiveness in the vicious cycle.

Results: While the predicted relationship between tinnitus handicap and anxiety was observed, this was fully mediated by depressive symptoms. In addition, we identified avoidant behaviours and self-blame as maladaptive coping strategies in people with chronic tinnitus and depressive symptoms, identifying potential new treatment targets.

Limitations: This work requires replication in a clinical cohort of people with chronic tinnitus, and further investigations of the role of coping strategies.

Conclusions: These results extend our understanding of the complex role of psychology in the experience of tinnitus, highlighting the importance of depressive symptoms that may be underpinned by functional disruption of specific neurocognitive networks. We have also identified depressive symptoms and maladaptive coping strategies as new treatment targets to improve the health wellbeing of people with chronic tinnitus.

1. Introduction

Chronic tinnitus is the experience of a phantom ringing, buzzing or hissing sound in the ears or head. Tinnitus is a significant public health issue that has substantive economic impact, with burden of disease calculations rating tinnitus ahead of prostate cancer and HIV/AIDS in Europe (Maes et al., 2013; World Health Organisation, 2011). Prevalence estimates for chronic tinnitus typically fall between 10% and 15% of the general population (Henry et al., 2005), although the sound of tinnitus has the potential to be experienced by 83% of people when in a silent room (Del Bo et al., 2008). The psychological impact of tinnitus is well recognised. 90% of chronic sufferers report life-style issues such as poor sleep, social withdrawal and interference with work, and 70% report emotional difficulties including suicidal thoughts, confusion and worry, creating a key platform for raising awareness of the condition as a global health problem (Tyler and Baker, 1983). Despite the prevalence and impact of tinnitus there remains no definitive cure or accepted understanding of the mechanisms that underpin the onset or maintenance of the condition.

The majority of early research investigated neurophysiological mechanisms for tinnitus at the level of the inner ear and peripheral auditory pathways (Eggermont and Roberts, 2004). The role of higher cortical factors was subsequently recognised, including neuroplastic changes in auditory and prefrontal cortices that may serve to maintain tinnitus (Schecklmann et al., 2013). Most recently, psychological factors have been considered, not just in terms of the comorbidity of tinnitus, but as fundamental mechanisms that drive the maintenance of tinnitus (McKenna et al., 2014). An initial psychological model proposed that high arousal or anxiety, and the subsequent negative emotional attachment to the sound, was the core mechanism underpinning a failure to habituate to the tinnitus sound (Hallam et al., 1984). This concept has since been incorporated into most models where it is central

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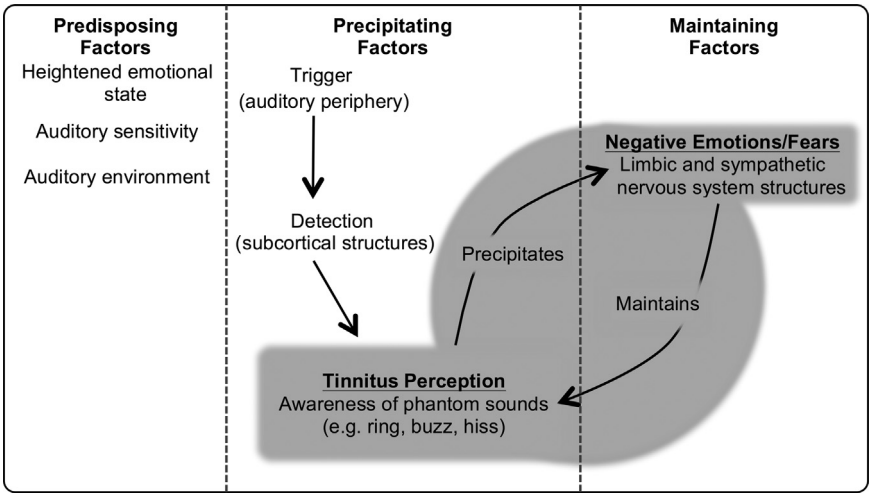

Fig. 1. Psychological framework of the neurophysiological model of tinnitus and the 'Vicious Cycle' (shaded) (Jastreboff et al., 1996). Note that the vicious cycle contains a precipitating pathway, where the onset of chronic tinnitus leads to negative emotions such as anxiety, which in turn reinforce tinnitus perceptions via the maintaining pathway.

to a 'vicious cycle' for maintaining tinnitus awareness through a feedback loop. The Neurophysiological Model of Tinnitus (Jastreboff et al., 1996) was particularly foundational in integrating auditory neurophysiology with psychological principles, such as negative reinforcement, which maintain the vicious cycle.

Arguably, the Neurophysiological Model of Tinnitus can be placed within a broader psychological framework that incorporates predisposing, precipitating and maintaining factors (Fig. 1). Precipitating factors principally relate to the perception of the tinnitus sound, with a lack of habituation of the random spontaneous activity of the peripheral auditory system serving as the 'trigger' that leads to the perception of a 'phantom auditory sound' (tinnitus). If this occurs within the context of predisposing factors, such as emotional arousal (e.g. anxiety), heightened sound sensitivity (e.g. hyperacusis), or a sudden change in the auditory environment, negative emotions can become associated with, and conditioned to, the phantom sound, leading to the onset of chronic tinnitus (the precipitating pathway). This is thought to be negatively reinforced by continued activation of limbic and sympathetic nervous system structures, which serves to maintain awareness and perception of the sound (the maintenance pathway), which in turn, strengthens the association between the sound and negative emotions via the precipitating pathway, creating a vicious cycle of hypervigilance (Fig. 1). As such, the association between negative emotions and the perception or awareness of the tinnitus sound drives the vicious cycle, rather than the psychoacoustic properties of the sound (e.g. pitch, volume) (Jastreboff et al., 1996). This model has formed the rationale for much of the current research on tinnitus in human and animal studies and thus, there is an emerging understanding of how emotion regulation, particularly anxiety, may be contributing to chronic tinnitus by maintaining awareness.

As a result of this work, anxiety has become a focal point for researchers. A recent systematic review found a significant increase in the lifetime and current prevalence of anxiety in people with tinnitus, in addition to evidence suggesting that common neural networks are involved in both conditions (Pattyn et al., 2016). Investigations of the relationship between tinnitus and anxiety have shown a moderate association, with above average state and trait anxiety ratings for almost 60% of participants (Ooms et al., 2012). A study of 75 audiology outpatients with tinnitus found 29% met DSM-IV diagnostic criteria for anxiety, 27% met criteria for an affective disorder, and 19% for a somatoform disorder (Marciano et al., 2003). Contrasting with these high prevalence rates of psychopathology, experimental studies often report scores in the subclinical or normal range for anxiety and mood (Simoens and Hébert, 2012), however this likely reflects varied sources of recruitment from community or clinical populations.

Further support for a role of psychological factors in tinnitus comes from the success of psychological therapies targeting anxiety and fears about tinnitus to break the vicious cycle, thereby reducing negative reinforcement of the tinnitus sound. In particular, cognitive behaviour therapies have been reported as effective in reducing the awareness and impact of tinnitus on people's lives (Cima et al., 2012). Also consistent with predictions of the vicious cycle, a range of neuroimaging techniques have shown increased activation of the anterior cingulate cortex, insula, parahippocampal gyrus and prefrontal cortex in people with tinnitus compared to those without (Husain, 2016). These regions form part of the affective and salience networks, as well as being implicated in both anxiety (Martin et al., 2009) and depression (Sheline et al., 2010).

Despite growing support for the relationship between tinnitus and anxiety, recent work has also established that a range of other psychological factors, such as depression, obsessive compulsive tendencies, and illness attitudes including somatisation tendencies, are involved in the experience of chronic tinnitus (Genç et al., 2013). These findings highlight the importance of considering potential mediators of the vicious cycle that maintains awareness of the tinnitus sound, as they suggest greater complexity in the psychological drivers of chronic tinnitus (Andersson and Westin, 2008). In other words, we need to identify factors that may contribute to the relationship between anxiety and tinnitus, such as latent traits or states that may help explain this relationship. It is also important to consider an individual's response to the daily experience of tinnitus since coping strategies, such as acceptance, have been found to be more adaptive for people living with chronic tinnitus (Hesser et al., 2015). Such strategies can be targeted in psychological treatments, facilitating the translation of experimental research to community and clinical treatment settings.

Thus, the aim of the present study was to identify the psychological mediators of the vicious cycle proposed to maintain the perception of chronic tinnitus. We first aimed to replicate evidence of the vicious cycle by demonstrating a relationship between tinnitus and anxiety. We hypothesised that this relationship would be mediated by psychological factors, such as depressed mood,