Theme 8: Impact of the built asset on health and wellbeing

Paper 1: Contemporary review of tinnitus in the built environment, and effective interventions at work and home

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Tinnitus is the perception of sound in the absence of corresponding external stimulus. Commonly described as a buzzing, whistling, or ringing sound, it often results from a damaged ear sending random and spontaneous signals to the brain. As described below, it often confers significant psychological distress, especially if the tinnitus has not been habituated to. Furthermore,

there is no cure for the condition – though several psychological interventions are discussed below. Specific working and leisure environments contribute disproportionately to development of tinnitus in employees. Furthermore, it is now clear that COVID-19 can cause and exacerbate the condition. We present a three-fold recommendation within the remit of the built environment to ameliorate risk of onset and support management of tinnitus. First, reduction of workplace noise. Second, incorporation of online psychological mitigation tools to promote acceptance of tinnitus in work and leisure spaces. Third, provision of suitable home and workplace environments. The important of multidisciplinary action is discussed.

Keywords: Cognitive Behavioural Therapy, Mindfulness, Psychology, Tinnitus.

Introduction

Prevalence of chronic tinnitus is estimated between 10-15% of the population (1 in 8), with 20% of tinnitus patients reporting significant reduction in quality of life and psychosocial wellbeing (Baguley, McFerran & Hall, 2013). It is more prevalent with age, with Shargorodsky et al. (2010) reporting chronic tinnitus to be present in 14.3% of Americans in the 60-69yrs age bracket. However, it is also present in 8% of the working population (Hébert et al. 2012), and the built environment makes significant contributions to tinnitus distress.

Although there are many causes of tinnitus, it is strongly related to noise exposure. It is often associated with professions such as military service, engineering, construction, mining, manufacturing, agriculture, and the music industry where high noise levels (≥85 dBA) or extensive exposure to noise are observed (Hong, 2016). In one study of 752 workers employed at 91 different workplaces, noise level and duration of noise exposure predicted risk of developing chronic tinnitus and permanent hearing loss (Rubak et al. 2008). Even with normal hearing, tinnitus has been described as a workplace safety threat through its capacity to interfere with verbal communication intelligibility, and localisation of sound (Cantley et al. 2015). Tinnitus has high comorbidity with clinical depression, anxiety and insomnia, and is associated with both concentration difficulties and

emotional distress. In a clinical setting, Zirke et al. (2013a) report that of 100 patients attending a tinnitus clinic, 37% were clinically depressed, 32% clinically anxious, and 27% had insomnia (with some overlap of conditions). While tinnitus can be described in audiological terms (e.g. pitch, loudness), it is important to note that severity of the condition is associated with psychological factors, and it is through psychological intervention that therapeutic progress can be made.

It is challenging to effectively treat tinnitus, partly because it is a symptom of many other conditions – e.g. Meniere's Disease (Gans, O'Sullivan & Bircheff 2014). There is no cure, no effective drug treatment, nor any intervention which is successful for most people most of the time (McFerran et al. 2019). The clinical aim is to reduce tinnitus-associated distress and to aid habituation (McKenna et al. 2017). It is most important to avoid situations where individuals with tinnitus are told by professionals unfamiliar with tinnitus that 'nothing can be done' (Henry et al. 2010). This increases anxiety and will further exacerbate tinnitus distress.

Treatment Pathways

Typically, the delay from diagnosis to treatment represents a significant stressor for the individual. However, Hesser et al. (2011) has shown that simply waiting for treatment can reduce tinnitus distress by 3-8%. This reduction has been explained in terms of an increased awareness of tinnitus symptoms, making it more likely that patients will seek to utilise their natural coping skills. Spontaneous improvement is also possible, dependent upon age and tinnitus severity – those with limited tinnitus distress may habituate while on the waiting list.

Tinnitus Psychoeducation

Information provision is a key foundation for most tinnitus interventions, commonly focusing on the processes that lead to tinnitus distress, coping mechanisms and the nature of tinnitus. While this reduces potential for confusion and misunderstandings, it can take at least two months for patients to integrate such information into their daily lives (Philippot et al. 2012).

Sound Therapy for Tinnitus

Properly-fitted hearing aids are often prescribed as a method of tinnitus management, but while there is significant benefit for individuals with accompanying hearing loss, a recent Cochrane Review only found one study of sufficient quality, so could not generate sufficient evidence to support/refute use of hearing aids in the treatment of tinnitus (Hoare et al. 2014). Alongside provision of hearing aids, sound generators are often provided. These usually produce white noise, either through a hearing aid or a noise-generating pillow (Baguley et al. 2013). For many individuals, these masking devices can reduce prominence of the tinnitus sensation, decreasing distress. However, in their systematic review of eight high-quality studies (n=590), Serada et al. (2018) were unable to evidence benefits of sound therapy for tinnitus in comparision with controls (waiting list) and an education/information cohort (no generator).

Cognitive Behavioural Therapy for Tinnitus (CBT-t)

CBT is the most common form of psychological therapy and is utilised for a range of different conditions, including anxiety, depression and chronic pain (Schütze et al. 2018). In therapy, it is used to challenge thoughts deemed irrational, unrealistic or illogical and reframe them into rational, realistic and logical ones (Gans, 2010). Interventions tend to span 8-12 weekly sessions, covering topics such as attention bias, applied relaxation and distraction techniques. Successful CBT benefits from being tinnitus-specific - indeed, this is essential - with evidence suggesting that CB -t can reduce tinnitus distress (Landry et al. 2020).

Mindfulness-based Cognitive Therapy for Tinnitus (MBCT-t)

Mindfulness-based therapies are increasingly accepted as a suitable treatment for tinnitus. Based on Buddhist philosophy, it was introduced to modern medicine by John Kabat-Zinn in the form of Mindfulness Based Stress Reduction (MBSR). 100s of research articles have been published on the benefits of mindfulness meditation, and it has been proven to be effective in treating tinnitus and depression (McKenna et al. 2017). The aim is to consider the present in a non-judgemental way, 'accepting' feelings and sensations. This enables the tinnitus patient to pay attention to the sensation

from a place of calm, to slowly learn to live alongside their tinnitus and habituate to it. Low trait mindfulness is known to predict catastrophizing and rumination, resulting in ineffective coping strategies (i.e. avoidance) and poor mental health and wellbeing. Developing higher levels of trait mindfulness through practice enhances the ability of individuals to positively appraise and accept their condition (Lindsay & Creswell 2017). Importantly, participant feedback is often very positive, enabling further utilisation of mindfulness in non-tinnitus contexts that has been shown to endure six months post-treatment (McKenna et al. 2017).

Mindfulness-based Cognitive Therapy (MCBT) and CBT have considerable overlap since they share underpinning theory. They target the thought process in qualitatively different ways, with CBT challenging the negative thought and MCBT seeking to mitigate and change the negative thought. Both encourage patients to coexist with their tinnitus rather than 'fighting it' (Marks, Smith & McKenna 2020; p1.), while benefitting from strong psychoeducational aspects.

Accessibility of Interventions for Tinnitus

While many forms of treatment exist, barriers to adoption are significant, including the health care system itself. For example, McFerran et al. (2018) report that 67.7% of tinnitus patients (n=937) were not offered any therapeutic assistance for their tinnitus once serious underlying causes were ruled out. Further, psychological interventions (CBT/Mindfulness) require input from psychologists who may not be available. Additionally, many individuals seeking a cure for their tinnitus are reluctant to seek psychological help for what they believe to be a physical condition. When travel, time restrictions and costs are considered, it is no surprise that individuals are further deterred from seeking psychological support (Ainscough et al. 2018). This is corroborated by the challenges of enrolling tinnitus patients into research studies. For example, Bauer et al. (2016) reported that 21% of participants who responded to advertisements subsequently declined participation – even when hearing aids were provided for free. As such, there is a movement towards the use of tinnitus self-help tools, particularly those that can be delivered online or through smartphone apps. Individual self-management of tinnitus is a key predictor

of habituation to the condition (Ainscough et al.), and as of July 2021 the British Tinnitus Association lists 116 UK-based tinnitus support groups facilitated by volunteers and individuals with tinnitus. In a study of 1,108 German tinnitus patients, Kofahl (2018) confirmed the importance of their voluntary nature, operating according to the wishes of their members. Self-help groups are “effective schools” (p.2176) which enable better coping skills in daily life, driven partly by a strong sense of community. However, Kofahl also notes that individuals with at least partial success in coping with tinnitus are much more likely to proactively seek out and participate in self-help groups. Enabling a sense of control – through participation – is an important step towards coping with tinnitus (Jackson, 2019).

For some, active involvement remains challenging. In such cases, coupled with a desire to remain anonymous, online treatment seems increasingly viable. Many self-help resources are available in the public domain (though not usually tinnitus-specific) and if evidence-based, can be effective in lowering anxiety and depression. However, 'guided' self-help is known to be more effective than 'pure' self-help (Richards & Richardson 2012). Increased self-agency and learnt resourcefulness outweigh the potential for social isolation and lack of a group setting, particularly if reaching individuals who would not otherwise participate.

Internet-based Cognitive Behavioural Therapy for tinnitus (iCBT-t) was pioneered in Sweden (Andersson et al. 2002), with 117 patients granted access to six self-help CBT modules or allocated to a waiting list (control). The iCBT-t group saw a dropout rate of 51% but remaining patients reported significant reduction in tinnitus distress and depression. Since then, the practice has become widespread – partially out of necessity due to lack of trained therapists. If undertaken correctly, it can also be cost-effective. Furthermore, due to evidenced-based improvements – for example, addition of discussion forums and weekly monitoring – iCBT-t outcomes are now broadly equivalent to those of face-to-face tinnitus interventions, even one-year post-intervention (Beukes et al. 2018).

Bimodal Neuromodulation

One example of a non-psychological treatment is Bimodal Neuromodulation. The concept is complex and outside the scope of this

paper but essentially, it combines sound (i.e. high-pitched noises) and electrical somatosensory stimulation (i.e. tongue stimulation) in such a way as to 'rewire' the auditory cortex for individuals with tinnitus. Conlon et al. (2020) enrolled 326 adults with tinnitus and over a 12-week period, participants were required to sit quietly with the device for 30 mins, twice a day, listening to sounds while wearing a tongue-tip stimulation device. 256 participants completed the treatment, with 81% of these experiencing an improvement in tinnitus symptoms after 12 weeks, and 77% after 12 months. However, inclusion criteria were strictly controlled (i.e. excluding complex cases), 20% of participants dropped out and were not considered further, the paper was not fully independent, nor was there an active control. The last point is critical, as there is a powerful placebo effect in tinnitus research (McFerran et al, 2019). In this case, patients were asked to sit quietly twice a day, which may have had a calming and anticipatory effect. Further, there are no details on whether information about tinnitus was provided, and it is known that provision of such information can have high therapeutic effect by itself (Philippot et al., 2012). Finally, 16% of study participants reported a worsening of their tinnitus post-treatment. While the technique remains an interesting line of enquiry, it currently lacks independent peer-reviewed evidence, and there is potential for worsening of the condition.

COVID-19 and Tinnitus

The COVID-19 outbreak was declared a global pandemic by the World Health Organisation (WHO) in March 2020 (Sohrabi et al. 2020), and since then has impacted on millions of people worldwide. Measures to counter COVID-19, such as lockdowns and social distancing, have resulted in social isolation, increasing anxiety and depression throughout the world (Vindegaard & Benros 2020). Tinnitus distress is known to increase during stressful periods (Mazurek et al. 2012), and in their survey of 3,103 individuals with tinnitus from 48 countries, Beukes et al. (2020) saw 31.5% describe a worsening of the condition (with 0.5% reporting improvement). At time of data collection only 237 had experienced COVID symptoms, with 128 of these reporting no change, 14 reporting improvement, and 95 (40%) reporting significantly worsened tinnitus. Distress due to social isolation/loneliness and lifestyle changes – related to the built environment

– can exacerbate tinnitus distress, as can COVID-19 itself. Though high quality COVID-19 studies are few due to the hurried nature of the research, the literature consistently reports that tinnitus is an early onset symptom of COVID-19, often lasting a few days/weeks, but also persisting in many cases. It is suspected that the mechanism by which COVID causes these symptoms is ischaemia (lack of oxygen) due to inner ear thrombosis.

In June 2021, the British Tinnitus Association reported that after 69.3 million doses of COVID-19 vaccines (UK), a total of 4,240 reports of adverse effects (tinnitus) had been signposted by the Medicines and Healthcare products Regulatory Agency. While the benefits of vaccination are clear, 1 in 9,600 people developed tinnitus, a side effect classified as 'rare'. Further, Munro et al. (2021) have reported that a significant number of COVID-19 patients noted deterioration in their hearing after hospitalisation, with 6.6% of hospitalised patients developing tinnitus afterwards. Finally, there is the spectre of long COVID. Tracking seven months of symptoms in an international cohort of 3,762 patients with confirmed COVID-19 symptoms, Davies et al. (2021) reported the lingering of 205 symptoms in 10 organ systems. One such symptom was tinnitus, a symptom reported by 11.5% of patients in week one post-COVID but after seven months, 26.2% of COVID-19 patients self-reported the presence of tinnitus for six months.

Conclusions

Chronic tinnitus is more prevalent in the working population than might be expected. It is unpleasant, has strong comorbidities with anxiety, depression and insomnia, and tinnitus distress is associated with increased concentration difficulties – specifically, greater cognitive inefficiency (Jackson, Coyne & Clough, 2014). Furthermore, noise levels and exposure to noise within the built environment are significant risk factors. As there is no cure for tinnitus, provision of a safe and healthy work environment is necessary. As determined by a recent systematic review (Chen, Su & Chen, 2021), periodic noise exposure monitoring, reduction of noise exposure to 80dBA or less (administrative/scheduling controls and ear protection), routine audiometric examinations, and continuous workforce education (e.g. repeated instruction in proper use of ear plugs) are key.

While many treatment options exist, many are expensive, may be unsafe (e.g. dietary changes), and lack a suitable evidence base. Currently, psychological interventions enabling the individual to live with the condition are the best options available. However, as discussed, enduring face-to-face therapy requires significant commitment and is determined by therapist availability. As the mean age of tinnitus onset drops (i.e. exposure to COVID-19), online and smartphone applications for tinnitus (iCBT-t and iMCBT-t) are increasingly viable. While such options are not designed to replace therapy, they are a gateway to understanding the purpose (and limitations) of psychological intervention, they are convenient to access and importantly, can be accessed at any time. As tinnitus distress is known to fluctuate throughout the day (Schlee et al. 2016), it is important that such resources can be accessed as needed, whether it is at the office during working hours or at home. Whenever needed, it is important that individuals with tinnitus can communicate with peers (tinnitus discussion boards, etc.)

Post-COVID it is likely that attitudes to the workspace will change. For many people, the global pandemic saw a movement to working from home wherever possible. And in some form, it is likely that this will continue. With some colleagues at home and others at work, it is likely that many meetings will continue in the online space. It is now widely known that virtual interactions are fatiguing (Toney et al. 2021), and this is partly due to online conversion not being synchronous (i.e. spoken words do not match the speaker's lips). There is distraction though chatbox use, limitations in non-verbal communication, and non-speakers are often engaged in other activity. Maintaining concentration is challenging, particularly for individuals with tinnitus and associated hearing loss, and support to mitigate such challenges can include provision of captions, a willingness to repeat key phrases in a different way, etc.

Finally, we must consider the value of a truly restorative environment, even an urban one (Janeczko et al., 2020). In a classic study, Ulrich (1984) considered the recovery of cholecystectomy patients in a US hospital. 23 patients with a window view of deciduous trees were compared to 23 other patients recovering in the same facility but lacking an external view. The former had a significantly shorter post-operative stay, fewer negative

evaluations from nurses, needed fewer doses of painkillers, and had fewer minor postsurgical complications. It is generally believed that the reason for these differences was based on the enjoyment of a natural scene and how it reduced anxiety in patients when compared with those given a monotonous experience viewing grey walls. As long as urban greenery is present, combinations of short walks and brief breaks during working hours have powerful effects on wellbeing, appraisal, and mindful states. Indeed, pleasant walks for the purpose of walking – not completion of goals – are restorative and can promote many of the therapeutic mechanisms observed in the literature (Gotink et al. 2016). As one example, mindful walking has significant value, as can be seen in a study by Teut et al. (2013). 74 participants were encouraged to walk regularly, but half of the sample were given structured sessions twice a week for a month. Encouraged to "mindfully observe and focus on bodily sensations while walking, remaining focused on their moment-to-moment experiences" (p.2), were reported improvement on both stress scales and quality of life measures. In the case of individuals with tinnitus, appropriate use of the built environment will improve mental health and wellbeing and decrease tinnitus distress through reductions in state anxiety.

Yet what is appropriate use of the built environment, and what does this built environment look like? In a recent examination of smoking adoption in the Chinese city of Yuxi, Davey & Zhao (2021) consider a crafted built environment in the form of sculptural installations and other landscape stimuli that encourage smoking as a form of group loyalty displaying pride in the region. If it is possible for the built environment to encourage unhealthy behaviour, it is also possible for the built environment to encourage healthy behaviour, promoting restorative exercise as a positive and valued pursuit which can reduce anxiety and, amongst other things, enable tinnitus habituation. A whole systems approach is necessary.

For example, it is possible to make ecological momentary assessment of tinnitus (Henry et al, 2012). In the last few years, with improvement in smartphone technology, it is increasingly possible to subjectively measure tinnitus in real time and conveniently. Furthermore, making use of a bespoke tinnitus-reporting app, Schlee et al. (2016) confirmed that regular reporting of tinnitus distress did not have significant negative influence on

the perception of the condition. In their study of 40 adults over six-weeks, Goldberg et al. (2017) noted that frequent tinnitus sampling can enable contextual understanding of factors affecting tinnitus, including emotional state (e.g. mood, stress) and location (e.g. level of noise, restorative environment), determining moment-to-moment vulnerability to bothersome tinnitus. Of great interest would be a widespread study identifying aspects of urban design (e.g. roads/highways, green spaces) and individual use of space which may moderate moment-to-moment tinnitus distress. Incorporation of an interdisciplinary approach involving architects, civil engineers, psychologists and urban planners would enable consideration of how the built environment could be shaped to reduce the anxiety of the user, enabling tinnitus habitation alongside broader and improvements in mental health and wellbeing.

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