Reducing risk of hearing damage in indoor live music venues through use of sound level management software

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Summary

Risks to the hearing health of patrons and staff in the music industry have been well documented and in recent years, regulations have been introduced in a number of European countries as a means of limiting sound exposure for attendees at live music events such as gigs, concerts and festivals. In Australia, sound levels at live music venues are generally stipulated in planning permits and/or liquor licenses but are largely focussed on preventing the emission of sound to neighbouring premises rather than reducing risks to hearing of patrons or staff. In this study, we investigated the use of a sound level management system (10EaZy) as a way of reducing exposure levels for patrons and staff, without interfering with patrons' enjoyment of the musical performances. More than 200 sound level measurements were taken in six inner-city Melbourne venues during live music performances before and after installation of the 10EaZy system at each venue. Measurements from the before- and after-periods were compared in terms of overall level (LAeq) and also the proportion of time spent at high volumes. Preliminary results suggest that use of 10EaZy resulted in significantly less time spent at higher volumes, particularly for loud performances. Results of subjective questionnaires indicated that patron satisfaction was unaffected when the 10EaZy system was in use.

1 INTRODUCTION

Music-induced hearing injury is a preventable, yet prevalent form of injury caused by cumulative over-exposure to sound affecting both musicians and the listening public. Symptoms commonly reported by exposed musicians include hearing loss, tinnitus, distortion and reduced sound tolerance. Despite the risks, the use of hearing protection by both parties to counter the risks remains low. Regulations and licencing that govern entertainment sound levels are generally framed and policed with regard to environmental considerations. Occupational Health and Safety requirements (ie $L_{Aeq,\ 8h}$=85 with a 3dB exchange rate) are usually a consideration for venue staff (eg bar and security) whereas responsibilities for other professionals (sound engineers, musicians) are rarely mentioned even though sound exposure in music venues commonly exceed those values. In smaller venues, band performances can get particularly loud as a consequence of the heuristics of electric guitar and drumkit playing. Given the likelihood that many musicians start their career as a performing artist in such smaller venues, putting their hearing health at risk, warrant extra consideration.

To better manage the risk to hearing, several countries have introduced legislation which impose limits on the maximum sound levels permissible in music venues. 10EaZy is a sound level management software system, designed to help venues and sound engineers adhere to sound level regulations. It does this by translating the time trade-off for high sound levels into a novel metaphor, known as ‘decibel-banking’. The interface displays each decibel above the target level in red, and each decibel below in green, continually informing the user as to how many decibels are ‘left in the bank’ as they aim for the set $L_{Aeq,\ 15min}$ target (15 minutes is a common timeframe but 5 and 60 minutes are also in use).

Systems like 10EaZy are commonly used for sound level management in music festivals and concerts, but at the time of this study, only anecdotal evidence for the efficacy of such a system in an indoor live music venue was available. The aim of this study is to investigate if access to the 10EaZy system, and implementation of a 15-minute maximum L_{Aeq} sound level, would result in lowered sound exposure of patrons and staff. Patrons were also canvassed as to their perceptions of any such change.

2 METHODS

This study was conducted under the ethics approval and oversight of the Royal Victorian Eye & Ear Hospital's Human Research Ethics Committee (project number 15/1225H). Invitations to participate were emailed to seven small-to-medium sized live music venues within the Melbourne metropolitan area, and six agreed to participate. A total of 271 patrons across the venues were surveyed (M = 29.46 years, range 18 < 65) and 93 staff members at the venue also participated (M = 28.05, range 19 < 48).

Version 2.6 of 10EaZy was placed at the sound desk of each venue, with the microphone left in a fixed location throughout the study. For the control phase this system recorded sound levels but was not used by the venue's team. During the experimental phase, however, each venue was instructed on how to use the 10EaZy's system and asked to nominate a $L_{Aeq\ 15\ min}$ target, using a summary of their initial sound levels as a guide.

Five noise dosimeters were used to measure LAeq and LCpeak sound levels in fixed locations, on two occasions in each venue; once during the control phase, and once in the experimental phase. These nights of dosimetry coincided with patron and staff surveys. These asked after their hearing health, use of hearing protection, and impression of the sound levels in the venue. A demographic survey requesting more information on the above was also sent to staff members of each venue.

3 RESULTS

Results of the hearing survey indicate a high proportion of patrons and staff surveyed had experienced symptoms of hearing injury post exposure at a live music venue (see table 1). Hearing protection was *never/rarely* worn by 71.2% of patrons and 44.1% of staff. Staff were also rarely afforded hearing care support by their employees, with none having previously been offered a hearing test by an employee, but 40.9% indicating they would find this beneficial.

Table 1: Experience of past hearing injury reported after attendance or work at a live music venue.

	Patrons		Staff	
Symptom	*n*	%	*n*	%
Tinnitus	147	55.20	47	50.5
Blocked sensation	61	22.5	18	19.4
Dullness	69	22.5	27	29.0
Distortion	50	18.5	16	17.2
Reduced Hearing	65	24	-	-
Otalgia	-	-	13	14
None	70	25.8	26	28

Preliminary results from sound exposure measurements at one of six venues in this study indicate that use of 10EaZy may benefit in sound level management, especially for loud performances. Chi-square analysis indicates a significant difference in patron satisfaction with sound levels between conditions, with the experimental (77.5%) preferred over the control phase (66.2%), $X^2 = 6.0\ (2)$, $p < .05$.

4 DISCUSSION

The data presented here is part of a preliminary analysis looking into the hearing health of patrons and staff in live music venues, alongside the investigation of use of 10EaZy as a means for sound level management. The initial results suggest 10EaZy may be an effective tool at reducing high sound levels, and that patrons respond favourably to its use. Experience of hearing injury by patrons and staff remains high, as use of hearing protection appears low. Education and support of both parties is required to support healthy hearing in the sector.