Providing earplugs to young adults at risk encourages protective behaviour in music venues

Beach, Elizabeth
Nielsen, Lillian
Gilliver, Megan

National Acoustic Laboratories
Australian Hearing Hub
16 University Ave
Macquarie University NSW 2109
Australia
P +61 2 9412 6983
F +61 2 9412 6769

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ABSTRACT

For some young people, nightclubs and other music venues are a major source of noise exposure arising from a combination of very high noise levels; relatively long attendance duration; and frequent, sustained participation over several years. Responsibility for hearing protection is largely left to individuals, many of whom choose not to wear earplugs. In order to encourage earplug use in these settings, a new approach is needed. The aim of the study was to examine whether presentation of hearing health information would result in increased use of earplugs, or whether provision of earplugs alone, would be sufficient to change behaviour. A total of Fifty-one regular patrons of music venues were allocated to a low-information (lo-info) or high-information (hi-info) group. Both groups completed a survey about their current noise exposure, earplug usage, and perceived risk of hearing damage. Both groups were also provided with one-size-fits-all filtered music earplugs. The hi-info group was also provided with audiovisual and written information about the risks of excessive noise exposure. After four weeks, and again after an additional 12 weeks, participants were asked about their recent earplug usage, intention to use earplugs in future, and perceived risk of hearing damage. The results showed that after four weeks, the hi-info group's perceived personal risk of hearing damage was significantly higher than that of the lo-info group. After 16 weeks, these differences were no longer evident. However, at both 4 and 16 weeks, both the lo- and hi-info groups were using the earplugs equally often, and both groups intended to use earplugs significantly more often in future than previously, regardless of the information provided to them. This suggests that the information was unnecessary to motivate behaviour change. Rather, the simple act of providing access to earplugs appears to have effectively encouraged young adults at risk to increase their earplug use.

Keywords

Music earplugs, noise-induced hearing loss, tinnitus, leisure noise, soft paternalism

An urban lifestyle involves almost constant auditory stimuli from various sources. People are continually exposed to sounds from the street environment, traffic, shops, and their own musical devices. Many young adults also regularly participate in recreational activities concentrated in urban centres such as nightclubs and live music concerts, at which the volume is loud enough to cause hearing damage (1-4). Repeated exposure to high levels of noise at music venues means this particular group is at heightened risk of developing tinnitus and noise-induced hearing loss or NIHL (5).

NIHL is the eventual result of long-term exposure to noise which causes cumulative damage to the outer hair cells of the cochlea. NIHL is an irreversible condition that results in a range of difficulties, including reduced overall audibility, inability to hear certain speech sounds, reduced dynamic range (which means louder sounds cause discomfort), impaired sound localisation, and difficulty separating sounds. These problems make it difficult for people with hearing loss to hear in noise, which leads to increased distractibility, auditory fatigue, and in many cases, social withdrawal and isolation.

Of particular concern are findings from recent animal studies showing that a single episode of excessive noise exposure results in damage to underlying neural structures which adversely affects auditory processing (6). This suggests that excessive noise exposure may have more damaging effects than previously thought and hearing problems in noisy environments may arise before the onset of permanent hearing loss (7, 8). In Australia and internationally, governments and public health organisations are concerned about the possibility of increased rates of tinnitus and NIHL and are seeking ways to promote healthy hearing behaviours and minimise the risk of hearing damage in target groups identified as high risk (9, 10).

Reducing the risk of hearing damage from music venues is particularly challenging because the exposure is voluntary, occurs during leisure time, and varies widely between

individuals, making blanket regulation difficult. Although workplace health and safety laws are in place to ensure a healthy environment for workers at such venues, no such regulations are in place to limit the noise level to which patrons are exposed. Rather, the responsibility for taking the initiative to reduce the risk of hearing damage is left to the patrons themselves. But how best to motivate individuals to protect their hearing in such circumstances? Many barriers exist including the fact that regular attendees may not even be aware of the risk associated with attending music venues (11, 12). Even if they are aware of the risk, they may dismiss it as unimportant because the consequences (i.e., hearing loss at a later age) are too subtle or long-term to warrant attention. Other factors also come into play such as consumption of alcohol and other drugs in nightclubs and similar venues, which may lead to a reduction in patrons' inhibitions and an increase in risk-taking behaviour.

Transmitting an effective hearing health message in this context presents a challenge. Typically, hearing health messages are presented in schools and workplaces and often include information about the anatomy of the ear, the physical properties of sound, noise level statistics and perhaps a demonstration of earplug usage (e.g., Dangerous Decibels [13]; hear4tomorrow [14]). Such strategies, which have been shown to be effective for increasing knowledge and improving attitudes of school students (15, 16), are impractical in nightclubs and live music venues. In such venues, where the risk is real rather than hypothetical, it is not enough to increase knowledge or change attitudes – here the aim is to *change behaviour* and to do so quickly. Thus, the music venue is a special case that requires hearing health practitioners to think creatively, and cast aside the usual hearing loss prevention models which are designed for more benign environments.

One option is to reduce the emphasis on health messages and information and shift the focus to practical behaviour change, i.e, use of earplugs. In countries such as Sweden, where earplugs are made available to venue patrons, earplug usage is up to six times higher than in

the US and Australia, where availability of earplugs at music venues is relatively rare (1, 17). These divergent usage rates suggest that availability of the protective device could be an important element in encouraging protective behaviour. This has long been recognised in adolescent sexual health programs, in which condoms are made freely available to teenagers at risk of unsafe sexual activity. These programs report higher rates of protected sex than programs which provide information and advice alone, suggesting a strong link between availability of the protective device and actual protective behaviour (18, 19). Similarly, programs offering participants free access to protective devices such as smoke alarms, bike helmets, and nicotine medication (patches or gum) have also reported increased compliance rates among those who received devices or medication, although the increased compliance was only temporary in the case of bike helmets (20-22). A meta-analysis of intervention programs aimed at encouraging the use of child safety seats in cars found that give-away programs, with or without accompanying education, were effective in changing behaviour, but there was little evidence to support the effectiveness of providing educational information alone (23).

In this study, we decided to explore (a) whether the use of a protective device (i.e., earplugs) could be encouraged in an at-risk group by making it freely available; and (b) whether usage could be enhanced by providing additional relevant information about the risks associated with music exposure. The aim of the study was to determine whether provision of earplugs, with or without accompanying information, would result in improved uptake of earplugs by at-risk music venue attendees. It was expected that provision of earplugs would result in increased future earplug usage, and that provision of relevant information would further boost the uptake of earplugs at music venues.

We also tested two secondary research hypotheses. Firstly, it was expected that the provision of information would increase participants' perceived level of risk associated with

attendance at loud music venues. Secondly, we expected that those participants who had experienced more signs and symptoms of hearing damage would show an increased intention to use earplugs in future compared to those with fewer symptoms of damage.

METHOD

This study was approved by the Australian Hearing Human Research Ethics Committee and all participants received a summary of the results of the study at its completion.

Recruitment

The target participants for this study were people who often attend loud music venues. This group was of particular interest because their lifestyle puts them at risk of developing NIHL in the future (24, 25). Participants were recruited by placing advertisements on Australian music websites: Inthemix, FasterLouder, and Mess+Noise. These websites were chosen to cover a broad range of music genres. Fifty-one people responded to the advertisements in which free earplugs were offered as an incentive to participate. Participants who completed all phases of the study received a $20 giftcard for an online music store, although they were not made aware of this incentive until just prior to the final phase of the study.

Participants

Participants were 14 females and 37 males, living in urban areas of New South Wales with an average age of 27.1 years (median: 26, age range: 20-39), reflecting the typical age of those most likely to attend nightclubs and live music events such as music festivals and popular music concerts (26). In general, the participants were highly educated: 53% had a

university degree, and 22% had completed other post-secondary education. These education levels are well above those of the general Australian population (in which 25% hold a university degree (27)). All participants were employed (71% full-time and 27% part-time) and/or studying (20%) at the time of the study. This group of highly educated, mostly male participants, predominantly aged between 20 and 29 reflects other studies of internet music site users which show a similar typical demographic (28, 29).

Procedure

Those who responded to the advertisement were contacted by telephone and a face-to-face interview was arranged. Stratified randomization (to ensure a balanced gender distribution) was used to assign the participants to two groups: high-information (hi-info) and low-information (lo-info). See Table 1.

INSERT TABLE 1 HERE

Face-to-face interviews

At the interview, all participants completed an online survey (the pre-survey) which asked about attendance at music venues, frequency of earplug use, symptoms of hearing loss, and noise and hearing damage. Although not statistically evaluated, the face validity of the survey questions was well established, having been developed by the authors and colleagues and used in several previous investigations into noise exposure and symptoms of hearing damage (4, 30-33).

Participants also received a set of Earpeace filtered one-size-fits-all music earplugs (34). A chart on the Earpeace website shows a relatively steep increase in attenuation between 125 Hz and 2 kHz, with relatively flat attenuation thereafter. The earplugs are designed and marketed for use at music events, and the attenuation range is between 11 and 17 dB (34). An audiologist (author 2) showed participants how to safely and correctly insert

and remove the earplugs. Participants were cautioned that the earplugs were not suitable for hearing protection in a workplace because the attenuation provided may not be sufficient.

In addition, the hi-info group was presented with educational information about the risks of loud music. This consisted of four items. The first two items were presented during the interview: (i) a 3-minute audio-visual presentation called "Preserving your hearing" (35) which included simulated tinnitus and hearing loss overlaid on speech and pop music samples; and (ii) a two-page brochure containing information about the decibel scale and general advice about how to reduce noise exposure and protect hearing, adapted from an existing brochure produced by Australian Hearing. The audiologist was present while the participants listened to the audio-visual presentation, and she read through the information brochure with the participants, explained the content, and answered any questions participants had about the material presented. An additional two items were emailed to those in the hi-info group after the initial interview: (iii) an audio-only 3-minute 4 kHz narrowband tinnitus sound simulation; and (iv) a link to the music-focused noise reduction campaign website "Music to my ears". Those in the lo-info group received no educational information or advice.

Follow-up surveys

Two follow-up online surveys were distributed to all participants via email. The first was sent four weeks after the initial interview, and the second 12 weeks later (i.e. 16 weeks after the initial interview). The follow-up surveys asked about recent attendance at music venues, use of earplugs, attitudes to noise and hearing damage, and intended future use of earplugs. Participants were also asked about how they found the earplugs in terms of comfort, communication, and usefulness and these results are published separately (36). Where appropriate, questions from the pre-survey were repeated in the follow-up surveys so that direct comparisons could be made between responses on all three surveys.

Forty-three participants (84%) completed the first follow-up-survey: 22 in the lo-info group and 21 in the hi-info group. Two patrons withdrew because of dissatisfaction with the earplugs, and the remaining 6 failed to complete the follow-up survey. The second follow-up survey was completed by 39 participants (76%): 21 in the lo-info group and 18 in the hi-info group. Two participants who completed the second follow-up survey did not complete the first follow-up survey so when comparing responses from all three surveys, the sample size totalled 37.

The test-retest reliability of the surveys was assessed by comparing responses on several noise-exposure questions that appeared in all three surveys. The correlation, *r*, between responses in the pre-survey and the first follow-up survey was .76, and the correlation between the first and second follow-up surveys was .74.

Data analysis

Responses to nine questions from the surveys were analysed as shown in Table 2.

INSERT TABLE 2 HERE

ANOVAs were performed to examine whether the lo- and hi-info groups differed in (i) their earplug usage; (ii) their intention to use earplugs in future, and (iii) perceptions of risk. A set of correlation analyses examined whether use or intended use of earplugs was associated with individual factors relating to (i) experience of symptoms of noise damage; and (ii) perceived difficulty hearing. These statistical tests were selected after examination of histograms and normal quantile-quantile plots showed that the earplug usage data were approximately normal. While the distribution of the risk perception data appeared to be non-normal, ANOVA was still used because simulations based on sampling from the data

suggested that the non-normality caused very little inflation of the type I error rate.

RESULTS

Venue attendance

All participants were regular attendees at music venues, specifically nightclubs, music festivals, pubs/bars, live concerts, and live gigs, i.e., live music events at small venues. As shown in Table 3, the average visits per year ranged from about once every 3 months for festivals to weekly for pubs. Most participants (82%) indicated they had used earplugs at music venues in the past. Most had worn foam earplugs, and about one-third had tried one-size-fits-all music earplugs.

INSERT TABLE 3 HERE

Symptoms of hearing damage

All but one participant reported having experienced auditory symptoms after visiting music venues, such as temporary threshold shift (76%), and tinnitus (92%). For 20% of participants, their tinnitus was reported as being permanent. One-third of the participants reported having trouble following a conversation in background noise, and 63% thought they had some hearing loss as a result of noise exposure. These incidence figures are much higher than identified in other studies of young adults (4, 37) which suggests that the participants in this study were exposed to more noise and were at higher risk of NIHL than the general population of young adults.

Access to additional information by hi-info group

In the first follow-up survey we asked the hi-info group if they had accessed the additional information items at home. Results showed that two-thirds of respondents (14/21) had listened to the tinnitus simulation while only 4/21 had visited the campaign website.

Earplug usage during the study

Responses to question 1a were examined to confirm that participants had trialled the Earpeace earplugs at music venues as requested. As shown in Table 4, during the first follow-up period, all but one participant used the Earpeace earplugs at music venues, and in the second follow-up period, nine participants reported not using the Earpeace earplugs in the previous four weeks, although five of them had worn other earplug types during this period. To determine whether there was a difference in the rate of earplug usage between the lo- and hi-info groups, a two-way repeated measures ANOVA was conducted. The between-groups factor was: hi- vs lo-info and the within-groups factor was survey: first follow-up (4 weeks); and second follow-up (16 weeks). The dependent variable was rate of earplug usage in the preceding four weeks with lower scores indicating more frequent usage: never (5); rarely (4); sometimes (3); most of the time (2); always (1). Results showed no significant main effect of group and no significant interaction, but there was a significant main effect of survey, $F(1,35)=15.95$, $p<.001$. This result shows that the lo- and hi-info groups used the earplugs equally often, but overall earplug use dropped from 'most of the time' ($M=2.4$) to 'sometimes' ($M=3.3$) between the first and second follow-up surveys.

INSERT TABLE 4 HERE

Future earplug usage

To examine whether receiving additional information provided an improvement in participants' intended future use of earplugs, we conducted five two-way repeated measures ANOVAs, one for each venue type. The between-groups factor was: hi- vs lo-info and the within-groups factor was survey (pre-survey (0 weeks); first follow-up (4 weeks); and second follow-up (16 weeks)). The dependent variable was rate of actual or intended earplug usage, with lower scores indicating more frequent usage: never (5); rarely (4); sometimes (3); most of the time (2); always (1). See questions 1b-c in Table 2.

The results showed a significant main effect of survey for all five venue types, $F_{pubs}(2,70)=9.1$; $F_{clubs}(2,58)=7.7$; $F_{concerts}(2,70)=13$; $F_{gigs}(2,68)=14.5$; $F_{festivals}(2,68)=14.3$, all *p*s <.01, but there was no main effect of group type for any of the venues. This means that regardless of whether additional information was received, both groups' intended rate of earplug usage improved from 'never (5)' or 'rarely (4)' at the pre-survey to 'sometimes' (3) or 'most of the time' (2) at the follow-up surveys. As shown in Figure 1, even though the intended usage rate dropped slightly at the time of the second follow-up survey, *t*-tests with a Bonferroni-adjusted critical *p*-value of .05/10 revealed that the difference in earplug usage was significant between the pre-survey and the first follow-up survey *and* between the pre-survey and the second follow-up survey for all five venue types, all *p*s < 0.004.

INSERT FIGURE 1 HERE

There was only one significant group x survey interaction, and this was for festivals, $F(2,68)=3.2$, $p<.05$). This result indicated that the lo-info group's intended earplug usage at festivals improved from 3.9 at the pre-survey to 2.4 at the first follow-up survey, but bounced back to 2.9 at the second follow-up (the same pattern observed for all other groups and venue types – see Figure 1). In contrast, in the hi-info group, intended earplug usage at festivals

improved from 3.3 at the pre-survey to 2.8 at the first follow-up survey and improved again reaching 2.5 at the second follow-up.

Perceptions of Risk

Next we examined whether receiving additional educational information affected participants' perception of the risk associated with loud music venues. We conducted two two-way ANOVAs, one for each risk type: personal and general. The between-groups factor was: hi- vs lo-info and the within-groups factor was survey (pre-survey (0 weeks); first follow-up (4 weeks); and second follow-up (16 weeks)). The dependent variable was perceived level of risk (where 1 = no risk and 10 = very high risk - see Table 2, questions 2 and 3).

For general risk, there were no main effects or interactions. For personal risk, there was a main effect of group, $F(1,35)=4.8$, $p<.04$, and the follow-up t-tests (using a Bonferroni-adjusted critical p-value of .05/2 showed that perceived personal risk was significantly higher for the hi-info group (M=8.9) compared to the lo-info group (M=7.7) after 4 weeks, $t(35)=2.4$, $p<.02$, but at 16 weeks, the difference in risk perception between the groups ($M_{hi\text{-}info}$=8.2 vs $M_{lo\text{-}info}$=7.5) was no longer significant, $t(35)=1.4$, $p>0.9$.

Noise exposure symptoms and self-perceived hearing difficulty

Since the sample studied here was a high-risk group, with a widespread incidence of noise damage symptoms, we examined whether earplug use was related to noise damage symptoms or self-perceived hearing difficulty. A series of correlation coefficients were calculated comparing earplug usage at each survey (questions 1b-c) with the experience of various noise damage symptoms (question 3). All correlations were non-significant (r coefficients ranged from: -.31 - .15).

Similarly, correlation coefficients were calculated comparing rate of earplug usage (questions 1b-c) and self-perceived hearing difficulty (aggregated responses to questions 4a-c). Again, there were no significant correlations between self-perceived hearing difficulty and earplug usage at any venue type for any of the three surveys (*r* coefficients ranged from: -.33 - .1).

DISCUSSION

The key finding of this study is that providing earplugs to a group of at-risk music venue patrons increased their intention to use earplugs at music venues in the future. Importantly, the intention to use earplugs was sustained over a 16-week period. As shown in Figure 1, few patrons said they intended to use earplugs all the time at the various music venues – the majority expressed an intention to use earplugs 'most of the time'. In the case of bars and pubs, more than half the participants indicated that they would not use earplugs at all in the future. This is presumably because patrons at bars and pubs wish to talk and socialise with others and are therefore reluctant to use earplugs in these settings. Equally, this result could reflect the fact that bars and pubs tend to be of generally lower volume than nightclubs, live music venues and festivals (38), and therefore earplugs are not necessarily required, or are not perceived to be required, to the same extent.

Prior to the study, we had expected that earplug usage might be correlated with participants' noise damage symptoms or self-perceived hearing difficulty as had previously been found (32, 39). However, this was found not to be the case, possibly due to a ceiling effect – all but one of the participants experienced symptoms and the majority reported at least some hearing difficulty.

The effect of information provision on future earplug usage was negligible. Both groups used the earplugs equally often during the study period, and both groups reported an

increased intention to use earplugs at music venues in future. A minor effect of the information provided was observed in intended earplug usage at festivals. Those in the hi-info group showed a slightly increased intention to use earplugs between 4 and 16 weeks rather than the slight drop in intended use observed in the lo-info group. This finding could be explained by the fact that music festivals are of much longer duration than other music events, some festivals lasting days rather than hours. Included in the material provided to participants was information about the importance of duration (as well as intensity) when calculating the risk of hearing damage from noise exposure. Perhaps this information was salient for the hi-info group, and thus they considered it when contemplating their future earplug usage at music festivals.

Information provision had a limited effect on participants' perception of noise-related risk. The hi-info group reported higher self-perceived risk four weeks after receiving the information, but this was not sustained at 16 weeks, when it returned to pre-study levels. This could be because providing information is an ineffective way of increasing long-term perceptions of risk, or it could be because the perceived risk of these highly noise-exposed participants was already at a uniformly high level and there was little scope for a significant sustained increase. Indeed, the participants in this study rated their risk at 8.1 out of 10, whereas in a previous study of 18-35 year-old Australians, average personal risk was rated at 4.8 out of 10 (converted from a 6-point scale) (33). This suggests that participants in this study were very well aware of their high risk levels, and for them, the provision of information likely had little effect because their self-perceived risk was already at near-ceiling levels.

Further evidence that the study sample was at high risk of hearing damage can be found in the widespread incidence of auditory symptoms following noise exposure. Ninety-two percent of the participants in this study reported they had experienced tinnitus after

visiting music venues, and 20% reported constant tinnitus. This is of serious concern, and indicates that regular high-noise exposure similar to that of our participants has the potential to cause auditory injury. In the short term, this could mean tinnitus and difficulty communicating in background noise, with the possibility of developing a permanent NIHL in the long term. Encouragingly, as mentioned earlier, the participants' self-rated risk level was high, which indicates a high level of awareness and furthermore, the participants' voluntary and eager participation in the study suggests a strong motivation to act to mitigate their risk. Other studies of successful give-away programs have shown that give-aways may be particularly effective for those at high risk because they are more motivated to adopt healthy behaviours (22).

Of the various theories and models which seek to explain how and why people are motivated to adopt certain healthy behaviours, the health belief model (HBM; 40, 41), and the stages of change (or transtheoretical) model (42, 43) are of particular relevance here. According to the HBM, those who decide to adopt a healthy behaviour, such as wearing earplugs, are those who believe in the severity of NIHL, and who consider themselves at risk of developing NIHL due to their noise exposure. They need to be convinced of the benefits of earplugs, overcome any barriers to wearing them, and also have the necessary self-efficacy (know-how and confidence) to wear them successfully. This characterisation fits well with what we know about the participants in our study - all of them considered themselves to be at high risk of NIHL and many had knowledge of the severity of noise-related damage because of their experience with auditory symptoms such as tinnitus and temporary threshold shift. The participants' use of earplugs both during and prior to the study would have made them aware of the benefits of earplugs, helped them overcome any potential barriers, and improved their self-efficacy in relation to earplugs. Thus, proponents of the HBM would argue that the participants studied here had all the necessary motivating factors for adopting earplug usage

as a healthy behaviour, and did not need any additional risk information. This explains why the information provided to the hi-info group proved to be ineffective for these participants.

The stages of change model also provides a satisfactory explanation for why providing earplugs (rather than information) was found to be an effective strategy for participants in this study. The stages of change model recognises that behaviour change is a dynamic process in which people's readiness to change evolves through a series of five discrete steps: pre-contemplation, contemplation, pre-action, action, maintenance (42, 43). Applying this framework to our participants, it seems obvious that they were well beyond the contemplation stages, and had moved to either the pre-action or action stages. That is, they had already recognised that their noise exposure was putting them at high risk, and had started taking steps towards earplug usage, either by trying various earplug types previously or by enrolling in the current study. Providing earplugs to this group of motivated participants was effective because they were well advanced in their risk awareness, and were ready to take action. They had little need of additional information, and required only access to the appropriate tool in order to act.

But what about other groups who might be less aware of the risks inherent in loud music venues? Would they also benefit from provision of protective devices, rather than information? Providing people with ready access to devices or tools that will reduce their risk of harm, such as earplugs, is consistent with 'libertarian paternalism', also known as 'soft paternalism' (44, 45). The concept was developed by behavioural economists after observing that even if people have all the relevant (health or financial) information to make choices that are in their best interest, they often fail to do so. Thaler and Sunstein (44, 45) argued that people are more likely to make better decisions if they are steered in a direction that promotes their welfare, and are given practical access to beneficial choices, rather than simply provided with information. Thaler and Sunstein maintained that so long as there is no coercion, a soft

paternalistic approach offers society a way of preserving people's freedom to make choices, while at the same time providing an effective, inexpensive, and non-intrusive method of changing behaviour (44, 45).

The results of this study suggest there may be some benefit in exploring how soft paternalist principles could be used to promote healthy hearing behaviours at music venues. The observed effectiveness of simply providing earplugs points to a new way of encouraging protective behaviours in music venues. A strategy that makes it 'easy' for patrons to choose the 'healthy option', i.e., earplugs, while minimising talk of ear anatomy and hair cells is likely to increase earplug use, particularly in motivated and high-risk patrons such as those studied here. Making earplugs freely (or at least cheaply) available at music venues would be an inexpensive and non-intrusive method of changing behaviour, and one that preserves freedom of choice while steering patrons towards a behaviour that is in their best interests.

Of course, the strategy that would be of most benefit for the hearing health of patrons of music venues is a reduction in volume levels. Improved design of venues, sound systems, and better education of DJs, musicians, and sound technicians would also contribute to reducing the risk of noise damage from music venues. Thus, promoting earplug usage should be approached as one of a suite of strategies to promote healthy hearing in music venues. The advantage of earplugs is that they are low-cost, immediately effective, and easy to implement, unlike other strategies which may involve expensive structural changes, investment in long-term education, or systemic change at the legislative level that could take years to eventuate.

Study Limitations

This study was conducted with a group of young urban-dwelling adults, who had significant levels of noise exposure, a relatively high risk of NIHL, and an awareness of that risk. Hence, these results may not be applicable to the general population, but similar results would be expected in other urban areas and within similar populations. To alleviate the

ceiling effects in terms of risk and symptoms of auditory damage symptoms that were evident in the results, a larger and more diverse representation of young adults would be required. If other low-risk and less-aware groups were included, the results would likely show that providing information is more effective in such groups because it would lead to increased perceptions of susceptibility, severity and risk, all of which are necessary first steps before protective action is taken.

Although we achieved a reasonably high retention rate in this study, a higher response rate for the follow-up surveys may have been achieved by conducting the follow-up surveys by telephone rather than online. The future intended uptake of earplugs by those who failed to respond to the follow-up surveys is unknown, but inclusion of these data may have affected the outcome of the study. Those participants who responded to both follow-up surveys may have had a more positive attitude to earplug usage than those who did not, and this too, may have affected the study results. Furthermore, there may be an element of 'social desirability bias' in some participants' responses, i.e., a tendency to provide answers that are viewed favourably by others. Although this is a possibility, we believe the likelihood of social desirability bias in this study is small for two reasons: (a) it is unlikely that this sample would over-estimate their earplug usage because previous research suggests that earplug usage is not a desirable course of action for most young people; and (b) self-administered and particularly web-based surveys (like the one used in this study) are less susceptible to social desirability bias and more likely to be accurate than other survey types such as computer-aided telephone interviews, interviewer-administered surveys or interactive voice recognition surveys because of their lack of direct contact with researchers and the perceived anonymity of the online format (46,47).

Conclusion

Although future research is needed to examine whether earplug accessibility, with or without accompanying information, is likely to be a successful strategy in encouraging earplug use in music venue patrons generally, the fact that this strategy seems viable in the highly exposed at-risk patrons studied here is very encouraging. It is precisely those who are most at risk that are most in need of targeted intervention in order to prevent auditory injury and future NIHL. Similar strategies, which also adopt a soft paternalist approach, are starting to be adopted more widely in other health domains (48, 49), and for at-risk music venue patrons, this approach has the potential to make a real difference to their long-term hearing health and their continued enjoyment of music.

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TABLES

Table 1 Participants in high-information (hi-info) and low-information (lo-info) groups.

	Hi-info		Lo-info	
	n	mean age	n	mean age
Males	18	26.7	19	26.4
Females	8	27.6	6	30.0
Total	26	27.0	25	27.2

Table 2 Questions and response options from surveys

	Earplug usage	**Response Options**
1a	Please indicate how often you have worn Earpeace earplugs/other types of hearing protection at music venues within the last four weeks.	Never (5); Rarely (4); Sometimes (3); Most of the time (2); Always (1)
1b	Please indicate how often you use earplugs when attending the following music venues: Music festival; Concert; Bar/Pub; Nightclub; Live gig[1].	Never (5); Rarely (4); Sometimes (3); Most of the time (2); Always (1); I do not attend such a venue (Null)
1c	In the future, how often do you intend to use Earpeace earplugs/other types of hearing protection at the following venues: Music festival; Concert; Bar/Pub; Nightclub; Live gig.	Never (5); Rarely (4); Sometimes (3); Most of the time (2); Always (1); I do not attend such a venue (Null)
	Risk	
2a	On a scale of 1-10, where 10 is high risk and 1 is low risk, how do you rate <u>your risk</u> of sustaining hearing damage from attending music venues?	Low risk (1) - High risk (10)
2b	On a scale from 1-10, where 10 is high risk and 1 is low risk, how do you rate <u>people's risk in general</u> of sustaining hearing damage from attending music venues?	Low risk (1) - High risk (10)

[1]A live gig was defined as a live music event at small-to-medium size venue.

Symptoms		
3	Have you experienced any of the following after attending music venues?	Ringing in ears/tinnitus; Ears feeling blocked or sore; Hearing feeling dull or temporarily impaired; None of the above
Self-perceived hearing difficulty		
4a	Do you feel you have a hearing loss?	Yes (1); No (2)
4b	Do you find it difficult to follow a conversation at home if there is background noise e.g. TV, radio, children playing?	Yes (1); No (2)
4c	Does an immediate family member or friend feel that you have a hearing loss?	Yes (1); No (2)

Table 3 Mean number of yearly visits at five music venue types (SD shown in brackets).

	Festivals	Concerts	Gigs	Nightclubs	Pubs
Average visits per year	4.3	16.3	32.0	35.7	52.6
	(4.8)	(20.6)	(25.0)	(29.1)	(21.8)

Table 4. Earplug usage during the study

Follow-up period	Group	Earplugs not used (n)	Earplugs used (n)	Types of earplugs used			Total (n)
				Earpeace only (n)	Earpeace + other (n)	Other only(n)	
1. Weeks 1-4	Hi-info	0	21	16	5	0	21
	Lo-info	1	21	19	2	0	22
2. Weeks 13-16	Hi-info	1	17	9	6	2	18
	Lo-info	3	18	11	4	3	21

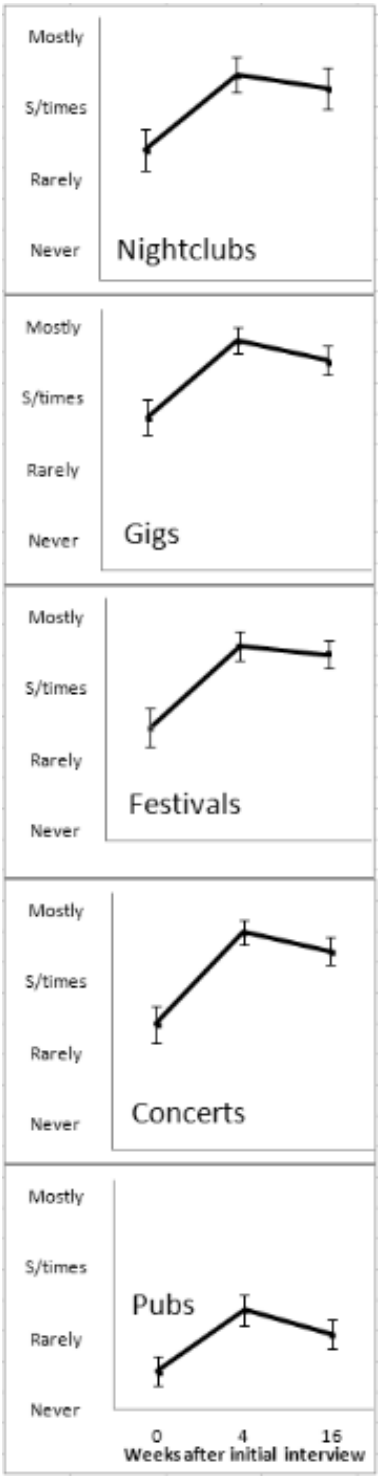

Figure 1. Earplug usage and intended earplug usage at pre, first follow-up and second follow-up surveys. Error bars = 1 standard error