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# FINAL REPORT

## Life time profiles of exposure to sound – what is a safe exposure? (Profiles)

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Department of Health and Ageing  
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## Preface

The study presented in this report was conducted by the National Acoustic Laboratories (NAL) for the Office of Hearing Services (OHS) as the result of a Hearing Loss & Prevention project grant.

The aim of the Project was to further existing research findings in order to provide a more comprehensive and accurate picture of the noise exposure of young people in the Australian community in particular with respect to non-work and leisure activities. Specifically the project is to provide an in-depth analysis and quantification of such activities that pose what could be considered a significant threat to long term hearing health.

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## Executive summary

Increasingly, young people are being exposed to potentially hazardous sound levels that may be harmful to their hearing, prior (or in addition) to any exposure they may receive in the workplace. Noise injury is rarely instantaneous, and its onset can be difficult to establish. It is often not until years later that damage is retrospectively associated with previous activities or events. To provide truly effective prevention programs it would be beneficial to be able to identify potential causes of hearing loss, rather than attribute retrospective blame.

This research has revealed that there are significant sources of potentially hazardous noise and sound that arise from many non-work and leisure activities. Surveys also provided estimates of participation rate in these activities over the life-cycle. While an individual's noise exposure over their life-time may be very difficult to estimate to any degree of precision, given the generality of the data collected it is now possible to make a first-order estimate of total noise exposure. First indications are that 10% to 15% of the population is potentially at risk. A note of caution should be mentioned here in that this risk applies to the age group under study and not for the population as a whole. The most significant and frequented noisy activities tend to be concentrated at a particular stage in the life-cycle commonly during the early twenties.

The results also established that there are a minority of individuals who are aware of the possible hazard to their hearing health as a result of their attendance at noisy leisure activities and they act directly in an effort to reduce their exposure by wearing personal earplugs. The insights into the motivation and self-efficacy demonstrated by these individuals to protect their hearing has provided impetus for further current work on the development of hearing loss prevention activities.

Some important figures that have been discovered so far are:

- Dance clubs possibly pose the greatest risk to the hearing health of young people;
- 13.2% of young Australians are at risk of hearing damage from 'Club' noise;
- Personal stereo players (PSP) commonly available on the Australian market can regularly put out noise levels of over 100 dB;
- The general trend for users of PSPs is to turn the volume down;
- Around 15% of young people attend dance clubs on a weekly basis;
- Individuals who regularly attend dance clubs are more likely to own a PSP and have the volume louder than other users;
- Only 17% of young people see under 35 year olds at risk of damaging their hearing;
- Some individuals do take care of their hearing when attending dance clubs;
- When considered as a group people are quite able to subjectively estimate the noise level of loud events;
- Individuals regularly judge their perception of their exposure to risk to be lower than that of their peer group.

While there has been an analysis of a considerable amount of data that has resulted in several peer reviewed journal papers and conference presentations the analysis of the results will continue for some time yet with more insights expected to be uncovered.

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## 2 Project detail, methodology and findings

### ***Research project rationale***

The damaging effects of high levels of noise exposure on hearing are well documented (WHO; 1980; 2001). This has created an increasing need to accurately identify sound sources that may be dangerous, and to quantify the hazard or risk they potentially present. To date, research has primarily been directed at examining noise exposure in workplace environments (WHO: 1997; Neitzel, Sexias, Goldman, & Daniell: 2004). As a consequence, the focus has generally been on documenting the amount and level of sound received throughout individuals' working years, often with a specific focus on designated "high risk" industries such as manufacturing, mining, transport and Defence (Monley, West, Guzeleva: 1994; Monley, West, Guzeleva, Dihn, & Tzvetkova: 1995).

While it is known that many non-workplace activities produce potentially dangerous sound levels, more information is required in order to determine the extent to which they present a genuine risk to individuals' hearing health. For example, in Australia there is currently much discussion in the media and the wider community about the effects of long-term personal stereo player use, attendance at 'rock concerts' and/or participation in 'dance parties' on the hearing health of children and young adults. Actual exposure to these and similar related sound sources is not well known. As a result, subsequent implications for resulting hearing loss are difficult to predict. The information needed includes typical sound levels; exposure durations; frequency of exposure; the number of years of exposure; and the proportion of the population exposed during these years. There is good evidence that the characteristics of the type and duration of various exposures to leisure sound systematically changes with increasing age (Biaassoni et al: 2005; Serra et al: 2005).

The modern environment therefore includes many potentially dangerous sources of sound. Despite this, little attempt has yet been made to systematically identify and document the full range of day-to-day activities that may pose a risk to a person's hearing. Very little is known about the relative contribution of work and non-work related noise at any given stage of an individual's life. Less is known about the relative contribution of different sound sources at different stages of life, even though these accumulate over the life of an individual. Current noise exposure guidelines are based on the assumption that people get all their noise exposure during an eight-hour working day, and that this exposure pattern continues five days per week for 40 years. With the decrease in the proportion of people engaged in heavy industrial activity, and the increased opportunities for leisure noise, existing standards and guidelines in no way reflect modern noise exposure patterns and may be in need of review

Although some work has been conducted in the area of noise exposure profiling, the data collected has provided far from comprehensive results. In some cases the information has been gathered as part of a larger project, resulting in profile data that is limited in scope. Many studies have relied upon a single data collection methodology; collecting either mainly subjective (Maasen et al: 2001) or mainly objective (Nietzel et al: 2004) data. Furthermore, all of these related studies have been conducted on overseas populations, with no data (that we are aware of) currently available that reflects Australian community profiles.

Without typical exposure times it is not possible to make a realistic estimation of the noise exposure and hence the potential hazard it poses. Currently it is estimated on the basis of audiogram shape that approximately 37% of all Australians over the age of 15 years, experience some form of high frequency hearing loss that is attributable to noise exposure (Wilson, Walsh, Sanchez, & Read: 1998). In a report on the cost of hearing loss to the Australian economy it was estimated that the annual cost of hearing loss to the Australian community is around \$11.3 billion dollars (Access Economics, 2006). If this is the case then reducing the effects of noise exposure would be of significant benefit to the Australian economy. This would be in addition to the reduction in social and personal cost for the individuals involved.

While quantifying the problem of noise exposure in general will not offer a direct solution to hearing loss due to noise exposure, it will identify the specific problems to which solutions have to be directed. There are also potential ramifications from this work on the recommended National Noise Exposure Standard for the workplace. If, as expected, leisure sounds are a significant source of hearing loss then perhaps noise exposure standards for the workplace will need to be reduced to allow for overall exposure. For these reasons, NAL has recently commenced research that will provide limited information about community noise exposure profiles.

Presently, a research project is being performed as part of the HEARing Cooperative Research Centre (CRC) with the goal of producing a noise exposure profile for selected groups within the community. The current focus of this research is to develop and pilot the necessary data collection methods (e.g. noise exposure diaries, interviewing/ focus group techniques, and dosimetry protocols).

Optimal use of resources meant that the project was limited to a broad-scale, shallow, sweep of the community using the above data collection techniques. This resulted in small-scale samples taken across a range of ages. Recent NAL research (Williams, 2005) has indicated that all of the people surveyed who were getting dangerous daily noise doses from MP3 players were under the age of 35 years. If young people's behaviours are, as suggested, placing them at high-risk for later hearing problems it is vital that these behaviours are identified in order to minimise the potential for future harm. Furthermore, it is important that researchers gain an accurate and realistic measure of sound exposure patterns for young people to more clearly define their noise exposure risk. This knowledge will enable us and others to develop appropriate education and intervention models that can provide better hearing outcomes across the lifespan. It will also enable us to develop noise exposure guidelines that more realistically reflect the variation of sound exposure over a lifetime that people are now exposed to. The research project outlined here proposes to build upon the tools developed within the existing CRC-funded project in order to conduct a more detailed analysis of the noise exposure of young people.

### ***Research aims and objectives***

This project aimed to build upon the existing research findings, to provide a more comprehensive and accurate picture of noise exposure for younger people within the community. In particular, the project aims to provide an in-depth analysis of the activities that pose the greatest potential risk for long-term hearing health, and to quantify that risk in terms of lifetime exposure standards.

This research will contribute to a better understanding of young people's risk of noise-induced hearing loss through:

- The construction of typical life-time noise exposure profiles for 18-35 year olds within the contemporary Australian (and New Zealand) community.
- Development and implementation of a web-based survey for the purposes of collecting additional qualitative and quantitative data across a large cross-section of young people within the community.
- Assessment of the relative "hazard" contribution that different activities and environments pose for 18-35 year olds' lifetime hearing health.
- A better understanding of the major hazards relating to noise induced hearing loss with the potential for better directed prevention activities/programmes and decreased incidence of hearing loss.

This will show us where to direct prevention strategies and will enable us to set realistic guidelines for the maximum safe exposure to sound for different activities at different stages of life.

### **Research methods**

The research was conducted so as to provide an in-depth and wide-scale analysis of the exposure to potentially dangerous levels of sound by 18-35 year olds, and to identify activities that pose the greatest threat to hearing health. This included noise measurements of individual leisure activities; dosimetry measurements of noise exposure of multiple research participants; research questionnaires; structured interviews; and large scale questionnaires.

The noise level measurements of individual leisure activities were conducted during visits to activity sites and were undertaken according to the requirements of combined Australian/new Zealand Standard AS/NZS 1269.2 Occupational noise management, Part 1: measurement and assessment of noise imission and exposure. Similarly dosimeter measurement followed the requirements in the same Standard. Dosimetry was conducted for varying exposure periods from a few hours to several days. The dosimetry was designed to determine the loudness level ( $L_{Aeq}$ ) of any exposure(s), the typical duration of the exposure(s) (T) and to establish if there were any further significant noise sources of which the researchers were unaware. Dosimetry participants were debriefed concerning their dosimetry results in order to ensure that the researchers clearly understood the participant's activities and the subsequent results.

A series of questionnaires and interviews were conducted at various times to gain information of the study population's knowledge concerning noise exposure, hearing health and other related topics. These were also coupled to structured interviews for more in-depth assessments during particular portions of the project.

The University of Technology, Sydney, a co-operative research partner funded by the grant, carried out broad on-line computer participation surveys of around two thousand individuals with the broad objective of estimating noisy leisure activity participation including frequency of participation, duration of participation at the individual event and 'participation-lifetime' (over what period of life is this activity undertaken). During the participation survey similar questions were also asked as through the questionnaires and interviews.

The details of the research procedures that were followed during the different phases of this research are not presented in this section of the report. For a detailed description of the methodology of the various parts of the project that have been published or have been presented for publication the reader is referred to the papers presented in the Appendix of this report.

### **Results**

Detailed and specific results are presented in the attached publications. It is anticipated that over the course of the next few years there will be a steady flow of work in the form of publications, peer reviewed and popular, and presentations, domestic and international.

Some specific salient points of note are:

- The noise exposure from activities such as dance clubs appear to be the most hazardous;
- Personal stereo player noise levels are generally decreasing but still represent a potential exposure hazard;
- Personal experience with tinnitus leads some people to appreciate risk and take protective action;
- The occurrence of tinnitus makes the risk of hearing loss tangible;
- Groups of people can estimate noise levels accurately; and
- The participation data from the large scale survey reinforced data gathered from smaller surveys.

The results as analysed so far have shown that there are sources of noise exposure arising from non-work and leisure activities many of which are capable of posing a significant risk to hearing

health. The magnitude of the problem is yet to be determined but should become clear after more detailed analysis of long term participation information.

However, that said, the majority of individuals would seem to have moderate noise exposure over their life-time and, as a group, are capable of estimating the loudness of 'noisy' events. If this is the case then it is estimated that in the order of 10% to 15% of the study population is at some risk of noise injury from their leisure activities. When this risk exposure is considered over the whole population the risk decreases, as the most popular and noisy activities tend to be concentrated in those in their early twenties.

### Key Findings

- 37% of all Australians over the age of 15 years, experience some form of high frequency hearing loss attributable to noise exposure. (This is a statistic from Wilson et al (1998) reproduced in Access Economics "Listen Hear! The economic impact and cost of hearing loss in Australia" (2006))
- 10% to 15% of the Australians between the ages of 18 and 35 years of age are potentially at risk of hearing loss caused by noise exposure.
- 17% of young people perceive that people under 35 years are at risk of hearing loss.
- 13.2% of young Australians are at risk of hearing damage from club noise.
- One in five (20%) of participants reported using Personal Stereo Players (PSP) at volumes perceived to be dangerous.
- In general self-reporting of PSP use matched actual measurement of PSP usage which suggests that self-reporting is a reliable method of identifying those at risk
- Participants overestimated peer listening behaviour. This may decrease motivation to change listening behaviour or even take notice of suggestions to reduce risk.
- The trend of PSP is for users to turn the volume down as they now tend to listen to a broader range of programming and not simply music. Overall listening and exposure levels, and hence risk of noise injury, are decreasing. However, it does not subsequently follow that the number of individuals at risk is correspondingly decreasing as there appears to be an increasing use of PSPs across society in general.
- There already exist a small group of young people who are aware of the risk of hearing damage and who take steps to minimise this risk.
- The cue which most prompted early adopters of earplugs was the personal experience of noise injury symptoms such as tinnitus/ringing in the ears.
- A common complaint about earplugs is that they have an adverse effect on music. This is especially the case for foam earplugs.
- The perceived relative merits of the three different earplug types (foam, ER-20 and custom) correspond well with both cost and pattern of uptake of earplugs. Most users started with cheaper, less satisfactory foam earplugs and progressed to either ER-20 or custom earplugs.
- Custom and ER-20 earplugs offer several advantages in addition to noise protection, these include enhancement of the wearers enjoyment of music and ease of communication as well as being discreet and comfortable. Yet these advantages are not recognised by non-earplug users.
- There is a wide range of output volumes from PSPs depending upon the device-earphone combination. More well-known and popular device-earphone tend provide higher output compared to those not so well known or as popular. This variation can be in the order of 40 dB. A consequence arising from the wide variation is that suggestions frequently made to legislatively limit PSP output would be unreliable.
- Noise levels experienced by regular attendance at nightclubs are well above the recommended noise exposure levels set for the workplace by all Australian WH&S jurisdictions. A person who regularly attends nightclubs on his 30<sup>th</sup> birthday has ears that are 30 years older than a non-clubbing counterpart.

### Recommendations

- Using the study information gained a trial is commencing in late June 2011 with the intention of encouraging more club attendees to use ear-plugs.

- Young people as a group are capable of making a reasonable judgement as to how loud noise actually is. Hence if provided with appropriate information and education such groups could self-initiate suitable prevention action to reduce the overall noise exposure if they decide the noise levels are sufficiently loud.
- Hearing health promotion activities may be more successful if misconceptions of peer listening behaviour are identified and addressed prior to the provision of more general preventative advice.
- Access to effective and affordable hearing protection is important for clubbers because high noise levels in Australian nightclubs are commonplace. ER-20 earplugs may be an acceptable cheaper alternative to custom earplugs.
- Web-based and peer-to-peer methods have the potential to change usage of earplugs.
- Analysis on a life-time exposure basis indicates that there is a potential significant risk to whole-of-life hearing health from clubbing and like activities, which warrants further investigation.
- Similar strategies to those for mitigating workplace noise exposure can be applied in recreational pursuits and in many situations this will require change in both attitude and behaviours of all those involved in the recreational activity.

## **A summary of published work, submitted work and work in progress**

### **\*Estimating young Australian adults' risk of hearing damage from selected leisure noise activities**

*E Beach, M Gilliver, W Williams*

#### *Abstract*

Leisure noise exposure has long been recognised as a source of excessive noise exposure that may contribute to long-term hearing loss. Although several research studies have attempted to estimate the percentage of the population at risk of hearing loss from leisure noise exposure, to date there have been no Australian studies examining this issue. In order to provide a realistic estimate of those at risk in Australia, this study measured noise levels at five known high-noise leisure activities using personal dosimetry and an online survey. The online survey was administered to 1000 18- to 35-year-olds, who reported the time spent at these five leisure activities, and the frequency with which they undertook the activities. The survey data, together with the average noise levels, were used to calculate personal noise exposure profiles and in turn, an Australian population estimate of those at risk of hearing damage from leisure noise exposure. The results showed that the vast majority of participants (n=868) accumulated a safe level of noise from the five leisure activities. However, 132 participants or 13.2% were exposed to an annual noise dose greater than the acceptable workplace annual noise limit, and this group experienced a greater incidence of tinnitus than those exposed to lower leisure noise levels. By far, the main source of leisure noise was from nightclubs, and therefore, it is argued that nightclub operators should be compelled to reduce noise levels, display warnings, and provide free earplugs for both patrons and employees.

\* In preparation

### **\*\*Music to whose ears? The effect of social norms on young people's risk perceptions of hearing damage resulting from their music listening behaviour**

*M Gilliver, L Carter, D Macoun, J Rosen, W Williams*

#### *Abstract*

Professional and community concerns about the potentially dangerous noise levels for common leisure activities has led to increased interest on providing hearing health information to participants. However, noise reduction programmes aimed at leisure activities (such as music listening), face a unique difficulty. The noise source that is earmarked for reduction by hearing health professionals is often the same one which is viewed as pleasurable by participants. Furthermore, these activities often exist within a social setting, with additional peer influences which may influence behaviour. The current study aimed to get a better understanding of social factors that may influence an individual's motivation to engage in positive hearing health behaviours. 484 participants completed questionnaires examining their perceptions of the hearing risk associated with music listening, and asking for estimates of their own and their peer's music listening behaviours.

Participants were generally aware of the potential risk posed by listening to personal stereo players (PSPs) and the volumes likely to be most dangerous. Approximately one in five participants reporting using listening volumes at levels perceived to be dangerous, an incidence rate in keeping with other studies measuring actual PSP use. However, participants showed less awareness of peers' behaviour, consistently overestimating the volumes at which they believed their friends listened.

Misperceptions of social norms relating to listening behaviour may decrease individuals' perceptions of susceptibility to hearing damage. The consequences for hearing health promotion are discussed, along with suggestions relating to the development of new programs.

\*\*Under review

**\*\*\*A qualitative study of earplug use as a health behaviour: The role of noise injury symptoms, self-efficacy, and an affinity for music**

*E Beach, W Williams, M Gilliver*

*Abstract*

The use of earplugs in loud music venues is confined to a small minority who wish to avoid hearing damage from excessive noise exposure. Using the framework of the health belief model (HBM), structured interviews were held with 20 earplug-wearing clubbers. Qualitative analysis revealed the HBM constructs relevant to understanding this group's motivation to protect their hearing. Personal experience of noise injury symptoms was the most common cue triggering earplug use. Awareness of the benefits of earplugs and appreciation of the long-term implications of hearing damage, affinity for music, and high self-efficacy were also key variables underlying this health behaviour.

\*\*\*In press

**Clubbing: The cumulative effect of noise exposure from attendance at dance clubs and night clubs on whole-of-life noise exposure**

*W. Williams, E. F. Beach, M. Gilliver*

*Abstract*

Anecdotally it has been suggested that exposure to some noise sources through leisure activities could have a significant effect on whole-of-life noise exposure. While exposure levels do vary, a typical night club or dance club attendee was found to experience an equivalent continuous A-weighted noise level of around 98 dB for up to 5 hours with an exposure of 12.2 Pa<sup>2</sup>h. This can extend up to 104 Pa<sup>2</sup>h in extreme cases. A study of "clubbers" reveals regular clubbing to be a source of high noise exposure, with a sustained period of regular club attendance contributing to a significant portion of whole-of-life noise exposure.

**\*\*The objective - subjective assessment of noise: Young adults successfully estimate loudness of events**

*E Beach, W Williams & M Gilliver*

*Abstract*

How does the psychological estimation of loudness correspond to the measured A-weighted equivalent continuous sound pressure level ( $L_{Aeq}$ ) sound pressure level as experienced by an individual listener? In this study, untrained young adults were asked to rate the loudness of events they attended. These ratings were compared to the actual loudness of the events, which had been objectively measured using personal dosimeters. The results showed that these young adults made a surprisingly good estimate of the noise level of events. Similarly when asked to estimate the 'noisiness' of their life-style, the group provided a realistic estimate of their average daily noise exposure.

\*\*Under review

**The Statistical Distribution of Expected Noise Level Output from Commonly Available Personal Stereo Players**

*W Williams, J Purnell*

*Abstract*

This work presents a summary of the equivalent at-ear sound levels that can be expected to be experienced by users of personal stereo players. Estimates of inter-device and inter-earphone variability are also provided along with variations in performance and maximum output levels. This variation in acoustic output levels may mean that attempts by users to control noise exposure by monitoring the electrical output may not be as simple as first envisaged. A simple method is provided for the estimation of PSP output level with respect to the volume setting.

**Trends in listening to personal stereos**

*W Williams*

*Abstract*

Long term use of personal stereo players (PSP) is now established as a potential risk to hearing health if exposure levels are not maintained at what are accepted as safe levels. Comparison of PSP user test results indicate that mean listening levels ( $L_{Aeq}$ ) have decreased from 86.1 dB in 2002/03 to 81.3 dB in 2008 and mean exposure levels ( $L_{Aeq,8h}$ ) have decreased from 79.8 dB to 74.7 dB over the same time period, in a user population whose mean age has increased from 23.6 years (SD = 5.7) to 26.0 years (SD = 10.5). This reduction in exposure level of 5 dB also means that the percentage of user population at risk of noise injury and subsequent hearing loss has decreased from 25% to 17% when judged by criterion commonly used for workplace occupational noise exposure standards.

**The Combination of Workplace and Recreational Noise Exposure**

*W Williams, M Burgess*

## Abstract

There are many noisy recreational activities undertaken by individuals during their leisure activities. How significant is noise exposure during recreational activities compared to noise exposure in the workplace? This paper reviews noise levels from common recreation activities. Comparisons are then made between possible noise exposures arising from work situations in combination with noise exposure from recreation activities. The findings indicate that the care taken to reduce noise exposure in the workplace can be swiftly negated with recreation noise dominating the overall exposure when recreation noise levels continue unchecked. If individuals are to maintain their hearing health they need to be more aware of the problems from exposure to excessive noise and to take preventative action similar to that used in the workplace.

## The Binge Listening Report

### Methodology

One thousand Australians aged between 18 and 35 years in metropolitan and regional locations in all states across all education levels participated in a 15 minute online survey. The questions related to their exposure to noise during leisure activities, their perception of noise, perceived causes of hearing loss and attitudes towards hearing protection. The research survey was conducted by Inside Story.

NAL conducted a study of actual noise levels at various locations using small portable noise dosimeters. Volunteers recorded noise levels by wearing the dosimeters while at entertainment venues, sports venues, during active recreation and at arts and cultural activities, and travel and domestic activities. Since May 2009, NAL collected more than 350 measurements of noisy leisure activities.

#### The dosimeter case studies

To support the survey and existing dosimeter research NAL conducted a study of leisure noise exposure in early 2010. Eight people, five female, three male, aged between 18 and 35 years old, living in the Sydney region participated in a four-day study of their noise exposure levels.

During this time, including a weekend, participants wore a dosimeter during waking hours and kept a diary of their leisure activities, including type of activity, time spent in activity, type of venue, proximity to the noise source, and approximate number of people attending. The dosimeter, worn on the body, measured and recorded the noise level of their surroundings.

#### Weekend 'binge listening'

From structured interviews with the dosimeter study participants, a trend emerged from the research: Although the participants seemed to be exposed to low levels of noise during their working week, their weekend leisure noise exposure was much higher. In some cases, leisure noise experienced on the weekend greatly exceeded the recommended weekly workplace noise exposure standard.

### Key findings

#### Common leisure activities among 18-35 year olds

- 15% of young people go to pubs once a week or more while nine per cent go to nightclubs once a week or more. A further 10% go to nightclubs once a fortnight. Most stay between one and five hours.

- Young people who attend nightclubs regularly are more likely to go to live bands, concerts and play their personal stereos 'loud' than those who go to nightclubs infrequently.

The risks of hearing loss as a result of these leisure activities

- Almost 40% said they have trouble hearing in background noise.
- Nearly three in ten said more than occasionally they have to raise their voice or shout to speak to someone an arm's length away. If you need to raise your voice or shout in order to be understood in background noise, then the noise has the potential to cause damage.
- The majority consider their risk of permanent hearing loss as a result of their current lifestyle and leisure activities to be small, very small or no risk, however, 25% have experienced tinnitus (ringing in the ears) after being exposed to loud noise and more than 60% of young Australians have experienced tinnitus at some point. Experiencing tinnitus after exposure to loud noise means that the noise level was loud enough to cause damage.
- Research conducted by NAL shows noise levels at nightclubs can range between 91 and 106 decibels, with an average of 98 decibels. Noise at 100 decibels can cause damage after 15 minutes.

Actual leisure noise exposure of young Australians

- 13% of young Australians are receiving a yearly noise dose from nightclubs, concerts and sporting activities which alone exceeds the maximum acceptable dose in industry.
- A further 12% receive a yearly noise dose of more than half the maximum acceptable dose in industry. See page seven to eight for more.
- Those who are receiving dangerous doses of leisure noise already report more symptoms of hearing loss than those who are receiving safe doses, despite all those surveyed being less than 35 years of age. This occurred whether the dangerous doses came from public events like nightclubs and dance parties, or from MP3 player use.

Perceptions and attitudes towards hearing loss

- While young Australians value their hearing, a significant proportion engage in leisure activities that may lead to hearing loss in the future.
- Only 17% of young Australians consider people less than 35 years to be at risk of some degree of permanent hearing loss.

**Participation report** (conducted in conjunction with the University of Technology, Sydney)

### **Attendance at entertainment venues: An empirical analysis**

#### **Conclusions**

This report has provided an empirical analysis of attendance trends at restaurants, pubs and nightclubs. To conclude the key findings are reiterated prior to a brief outline of recommendations stemming from this report.

#### **Restaurants**

Attending restaurants is a popular pastime for Australian 18-35 year olds, with a higher proportion of respondents attending eateries than pubs, or nightclubs. Furthermore, this report demonstrated that the most popular nights to attend a restaurant fall on Friday and Saturday. Despite the popularity of restaurants and the high proportion of respondents that

attended, the general consensus in survey data was that the noise levels in eateries were relatively low when compared with pubs and nightclubs. This point was backed up by the minimal proportion of attendees that experienced symptoms of hearing damage after attending restaurants. Additional testing by audiologists is required to validate noise levels within restaurants. Furthermore, additional survey data should be gathered to better model how type of restaurant influences perceptions of noise exposure.

### **Pubs & Bars**

Approximately 50% of respondents attended a pub in the week leading up to this survey process. However, data indicated that attendance at pubs an activity, which lasted for over 3 hours in duration. This finding was tempered by the fact that attendance at pubs and bars was a relatively infrequent activity across the two surveys. In accordance with restaurant data, Friday and Saturday were the most popular times to attend a pub – they were also perceived as being the loudest. However, pubs and bars were rated by participants at over 4 on the 5-point Likert scale, which indicates a perception that these entertainment venues are noisier than restaurants. This finding was backed up symptomatically, through a higher proportion of pub attendees experiencing symptoms of hearing damage than at restaurants with over 30% of respondents in each survey reporting one, or all hearing symptoms tested. Finally, in the student sample used for survey one 29.2% of respondents went from the pub to a nightclub. This was far lower in the second survey with only 9.2% of respondents reporting that they went from a pub to a nightclub, or restaurant. The younger student sample appeared more likely to attend pubs and nightclubs in the same night. Future research is required to explore in further detail the relationship between pub and nightclub attendance to understand the extent to which individuals use both venues in the same night.

### **Nightclubs**

The conclusions in relation to nightclub data are mixed. Firstly, it is encouraging that a lower proportion attended nightclubs than reported for restaurants and pubs and nightclubs. Survey one data reported that 22.4% of respondents attended nightclubs, while survey two data reported a lower figure (13.8%). However, data also showed that attendance at nightclubs began at the age of 18, or before. Most worryingly, respondents that attended nightclubs spent almost 4 hours at the venue in survey one and 3.5 hours in survey two leading to a significant noise dose. Despite the hefty duration of attendance when people did attend nightclubs, the frequency of attendance was infrequent across both surveys with only 2% of respondents attending more than once a week. As with restaurants and pubs, Friday and Saturday were the most popular days to attend. However, the key finding in relation to nightclubs centered on the proportion of attendees reporting symptoms of hearing damage after attending nightclubs. In both surveys more than 60% of respondents reported experiencing at least one symptom of hearing damage after attending a nightclub. Future research is required to specifically target attendees of nightclubs to ascertain whether this figure is applicable to a broader sample of nightclub attendees. Furthermore, this survey has indicated that nightclubs are of specific interest to both audiologists and leisure scientists in the future.

### 3 Dissemination of the findings

#### **Publications**

The findings of the project have been published in peer reviewed journals and as technical or professional reports in international and Australian journals such as the *International Journal of Audiology, Noise & Health*, the *Acoustics Bulletin*, *Acoustics Australia*, the *Journal of Health Psychology*, *The Health Promotion Journal of Australia* and *Audiology Now*. The results were combined with the results of other projects to produce the Australian Hearing (2010) report entitled *Binge Listening: Is exposure to leisure noise causing hearing loss in young Australians?*, which described for a general audience the hearing health implication of leisure noise for young Australians. This report, and the media attention it generated, led to extensive public dissemination of hearing awareness information throughout Australia and New Zealand. The report was launched to a large audience at the Audiology Australian XIX<sup>th</sup> National Conference 2010, Sydney and well covered by local and national media.

#### **Summary of published and submitted work**

\*\* Beach, E, Williams, W & Gilliver, Estimating young Australian adults' risk of hearing damage from selected leisure noise activities in preparation

\*\*Beach, E, Williams, W & Gilliver, M (201X) The Objective – subjective assessment of noise: Young adults successfully estimate loudness of events and life-style noise, submitted to *Ear and Hearing*, March 2011

\*\*Gilliver, ME, Carter, L, Macoun, D, Rosen, J & Williams, W (201X) Music to whose ears? The effect of social norms on young people's risk perceptions of hearing damage resulting from their music listening behaviour, submitted to *Noise & Health*, April 2011

Beach E, Williams W, Gilliver M (201X) A qualitative study of earplug use as a health behaviour: The role of noise injury symptoms, self-efficacy, and an affinity for music, *Journal of Healthy Psychology*. Accepted, May 2011

Williams, W & Purnell, J (2010) The statistical distribution of expected noise level output from commonly available personal stereo players, *Acoustics Australia*, 38(3): 119 - 122

Beach, E, Williams, W, Gilliver, M (2010) Hearing protection for clubbers is music to their ears, *Health Promotion Journal of Australia* 21(3): 215 - 221

Williams, W, Beach, E & Gilliver, M (2010) Clubbing – the cumulative effect of noise from attendance at dance clubs on whole-of-life noise exposure, *Noise & Health*, July - September 2010, 12:48, 155 – 158

Australian Hearing (2010) Binge Listening; Is exposure to leisure noise causing hearing loss in young Australians? Report by Australian Hearing and the national Acoustic Laboratories, Chatswood, May 2010 [available at <http://www.ebooks.geongroup.com/AusHearing/Report2/Index.aspx>]

Williams, W (2009) Trends in listening to personal stereos, *The International Journal of Audiology*, Vol 48(11): 784 - 788

Williams, W & Burgess, M (2009) The Combination of Workplace and Leisure Noise Exposure, *Acoustics Bulletin* Vol 34(2): 30 - 33 March/April

Williams, W (2008) How significant is leisure noise exposure over the life-cycle?, Professional Issues, *Audiology Now*, Issue 35: pp 44 – 45, Summer 2008

Williams, W (2008) Life-time leisure noise exposure – Is it time to look at the bigger picture? Acoustic Opinion, *Acoustics Australia*, Vol 36(2): 64 – 65

Notes: \*Accepted, in print; \*\*Submitted

### ***Presentations***

The presentation of results has also been carried out at International and Australian conferences. These include the International Congress of Acoustics (Sydney, 2010); the 12<sup>th</sup> Asia-Oceania Otolaryngology Congress (Auckland, 2011); INTER-NOISE 2009 (Ottawa, 2009); Annual Conference of the Australian Acoustical Society (Adelaide, 2009); Audiology Australia XIX national Conference (Sydney, 2010); National Hearing Conservation Association Conference (Florida, 2010); the Spring Symposium on Audiology (Auckland 2010); the Deafness Forum - Sixth National Deafness Summit (2010, Sydney); and the 20th National Australian Health Promotion Conference .

### ***Summary of presentations***

#### ***2010/2011***

Beach EF, Freeston K, & Pang J. (2011) Leisure-noise induced hearing loss: Prevalence, profiles, and prevention. Australian Health Promotion Association 20th National Conference. Cairns, Australia, 10-13 April, 2011.

Beach, EF. (2011). Research findings on leisure noise exposure in young adults. Keynote presentation at XXVI<sup>th</sup> Annual General Meeting of the Australian Tinnitus Association (NSW Limited. 2nd April 2011, Sydney.

Williams, W (2011) Expected output levels from personal stereo players or PSPs, Australian Acoustical Society Technical Talk, NAL Chatswood, March 24th, 2011

Williams, W (2011) The shape of entertainment noise, an invited presentation, 12th Asia-Oceania Otolaryngology Congress, 01st – 04th March, 2011, Auckland, New Zealand

Williams, W (2010) Leisure Noise and the Calculation of Life-Time Dose, Spring Symposium on Noise-induced hearing Loss, Status of N-IHL in New Zealand – what we know, Auckland November 29th, 2010

Williams, W (2010) Work and non-work noise exposure, proceedings of the 20th International Congress of Acoustics, ICA 2010, 23 – 27 August, 2010, Sydney, Australia

Beach E, Williams W and Gilliver M (2010) The contribution of leisure noise to overall noise exposure, 20th International Congress on Acoustics, International Congress of Acoustics 2010. Sydney, 23-27 August 2010.

**2009/2010**

Beach E, Williams W and Gilliver M (2010) The contribution of leisure noise to overall noise exposure, 20th International Congress on Acoustics, International Congress of Acoustics 2010. Sydney, 23-27 August 2010.

Gilliver, M, Carter, L, Williams, W, Macoun, D, Rosen, J, Gibian, M, Freeston, K, & Dillon, H (2010) Music to Their Ears; How Can Young People's perceptions About Their Listening Habits Aid Prevention Strategies? , Audiology Australian National Conference 2010, Sydney

Beach, E, Williams, W, & Gilliver, M (2010) Earplugs for Clubbers: Once you get used to them, you can't do without them", Audiology Australian XIX National Conference 2010, Sydney

Carter, L, Williams, W, Gilliver, M, Macoun, D, Rosen, J, Pang, J, Gibian, M, Freeston, K, & Dillon, H (2010) iHEAR – Prevalence of hearing loss and its relationship to leisure-sound exposure, Audiology Australian National Conference 2010, Sydney

Williams, W (2010) The delivery of hearing loss prevention programmes, Sixth National Deafness Sector Summit, Deafness Forum of Australia, Sydney April 23 – 24, 2010

Williams, W (2010) Noise Exposure Profiles, National Hearing Conservation Association, 35th Annual Conference, February 25th – 27th, 2010, Orlando, Florida

Williams, W (2010) Current moves in Australian based noise exposure research, National Hearing Conservation Association, 35th Annual Conference, February 25th – 27th, 2010, Orlando, Florida

Lock, D, Murphy, A, Veal, T, Williams, W, Gilliver, M & Beach, E (2010) Investigating the leisure noise nexus in the Australian context, Australian New Zealand Association for Leisure Studies conference 'Exploring new ideas and new directions', 2nd – 4th February 2010

Williams, W (2009) Noise exposure profiles, Annual Conference of the Australian Acoustical Society, 23rd – 25th November, Adelaide

Burgess, M & Williams, W (2009) Noise management plans for leisure? INTER-NOISE 2009, August 23rd – 26th, Ottawa, Canada

**Popular press**

There have been numerous reports in the popular news media including television, newspapers, periodicals and radio by NAL project staff. This work with the popular press normally consists of a slow, but regular trickle of enquiries in the order of two or three times per month. However, after the launch of the *Binge Listening* report there was an intense flow of interviews for many members of the Prevention Section and the Research Director at NAL. Contacts and responses were in the order of fifty enquiries over the period of the first few months after the report's release. These enquiries continue twelve months after the release and the report content forms the basis of many responses.

## 4 Implementation of the findings into practice

The results have implications for how and where to best direct and hearing loss or noise exposure reduction programmes for the greatest outcome.

A major result was that dance clubs are the major source of leisure noise exposure for young adults.

Further published work concerning club attendance (Beach, Williams, Gilliver: 2010; Beach E, Williams W, Gilliver M (accepted May 2011) ) established that there is a definite sub-group of club attendees who regularly use ear-plugs while exposed to loud music while on the dance floor. This voluntary and intentional use has developed from personal experiences of temporary impairments from exposure to noise and a desire to continue to attend while simultaneously maintaining healthy hearing. Using study information gained a trial is commencing in late June 2011 with the intention of encouraging more club attendees to use ear-plugs. The objective is that in the future more Club attendees may be encouraged to protect their hearing from the loud music on the dance floor while still being able to enjoy clubbing as an activity.

Similarly the encouragingly positive results of the subjective evaluation of loud noise exposure compared to the objectively measured levels (see Beach, E, Williams, W & Gilliver, M (201X) "The Objective – subjective assessment of noise: Young adults successfully estimate loudness of events and life-style noise", submitted to *Ear and Hearing* March 2011) indicates that groups are capable of making a reasonable judgement as to how loud noise actually is. Hence if provided with appropriate information and education such groups could self- initiate suitable preventative action to reduce their overall noise exposure if they decide the noise levels are sufficiently loud.

The *Binge Listening* report (Australian Hearing: 2010) has had excellent reception in Australia and New Zealand and has raised the awareness of the cyclic nature of some leisure time noise exposure activities and the subsequent possibility of noise injury. Information was presented in such a way as to remove any scientific mystery and present the research results in plain language. As a result, further work and publicity is continuing along this line.

## 5 Evaluation of the research project

The evaluation of the various aspects of the project has been provided through the acceptance of publications into peer reviewed literature, International and Australian academic publications.

At all times the research projects conducted at NAL are regularly reported to and reviewed by the Australian Hearing Research Committee while all ethical considerations are monitored by the Australian Hearing Human Research Ethics Committee. By following the processes and procedures established by the committees strong quality control is maintained on all projects and research programmes.

## 6 References

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## 7 Appendix - Project output (as of June 2011)

### **Published and submitted work (Attached)**

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