THE COMBINATION OF WORKPLACE AND RECREATIONAL NOISE EXPOSURE

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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.

1.0 INTRODUCTION

There are two criteria for occupation noise exposure applicable in Australia and New Zealand (NOHSC (1007): 2000: HSER: 1995); one for continuous noise and the other for impulse noise. For continuous noise, the eight hour A weighted equivalent, continuous sound exposure, $L_{Aeq,8h}$, must not exceed 85 dB[1]. This is the steady noise level that would, in the course of an eight-hour period, represent the same sound energy as that due to typical workplace noise, which usually varies over time. Noise exposures for shorter or longer periods must be normalised to an 8 hour period for the assessment and an equal energy concept is assumed where for an increase in level of 3 dB a halving of the exposure time must be applied and *vice versa*. For any impulse noise exposure, the C weighted peak sound pressure level, L_{Cpeak}, must not exceed 140 dB. This criterion is usually only exceeded during exposure to high impulse noise such as that from firearms, explosives or high powered impact tools.

It is important to understand that the exposure criteria values are not set at values that represent a "safe" exposure, at which no one would be expected to suffer harmful effects. Rather, they are set at values that represent a level of 'acceptable risk' for the general working community. For example, it is estimated (ISO 1999:1990; AS/NZS 1269.4:2005) that when noise exposure in terms of $L_{Aeq,8h}$ is limited to 85 dB for a working life of 40 years, 74% of an exposed otologically normal male population would on average suffer a 6% hearing loss – sufficient to lodge a successful hearing compensation claim in many jurisdictions.

The exposure criterion for $L_{Aeq,8h}$ is based on the assumption that, after the working day, the remainder of the 24 hours and the weekend are spent in a quiet environment (less than 75 dB). In order to compensate for any reduction in recovery time for long work shifts the assessment method (AS/NZS 1269.1:2005) includes an adjustment (shift loading) which is added to the worker's $L_{Aeq,8h}$ before comparison with the criterion, i.e: for a shift length of between 10 to 14 hours the adjustment is +1 dB; for 14 to 20 hours, +2 dB; and for 20 to 24 hours, +3 dB. 1.

While noise is conventionally defined as 'unwanted sound', it is generally accepted that excessive 'wanted sound', such as music or sporty cars, will also cause hearing loss (Chassin: 1996). With this in mind no distinction in this paper is made between what can be considered as the psychological difference between noise and sound. It is also assumed that the sound energy associated with recreation activity noise has the same effect on hearing as does the sound energy produced by workplace noise.

2.0 NOISE LEVELS FOR RECREATION ACTIVITIES

While there may be a system in place for managing excess noise in the workplace, many people inadvertently (or deliberately) expose themselves to high levels of noise during recreational activities. The noise levels experienced during some common recreational activities are discussed in the following sections. This is not a comprehensive review but rather aims to provide an indication of the range of noise levels possible from various recreational activities.

2.1 Amplified music in clubs, concerts

Concerns have been expressed about the high levels of noise experienced in clubs, pubs, concerts and other venues with music. While there has been some discussion about the effect on the patrons, most research has been directed toward assessing the risk for the workers at such venues (Sadhra, Jackson, Ryder & Brown: 2002; Groothoff: 1999; Guo & Gunn: 2005).

As part of their '*Don't lose the music*' campaign, the Royal National Institute for the Deaf (RNID) in the UK published noise level data from three nightclubs in each of five UK cities. The clubs in each city were chosen on the basis of music style to ensure the samples included one house style, one pop style and one drum, bass, dance style. In terms of L_{Aeq}, the average noise level on the dance floor ranged between 90 and 110 dB.

1. The convention adopted here will be not to duplicate the A or the C after the unit dB to represent the weighting when it is included in the descriptor, ie L_{Aeq} and L_{Cpeak}.

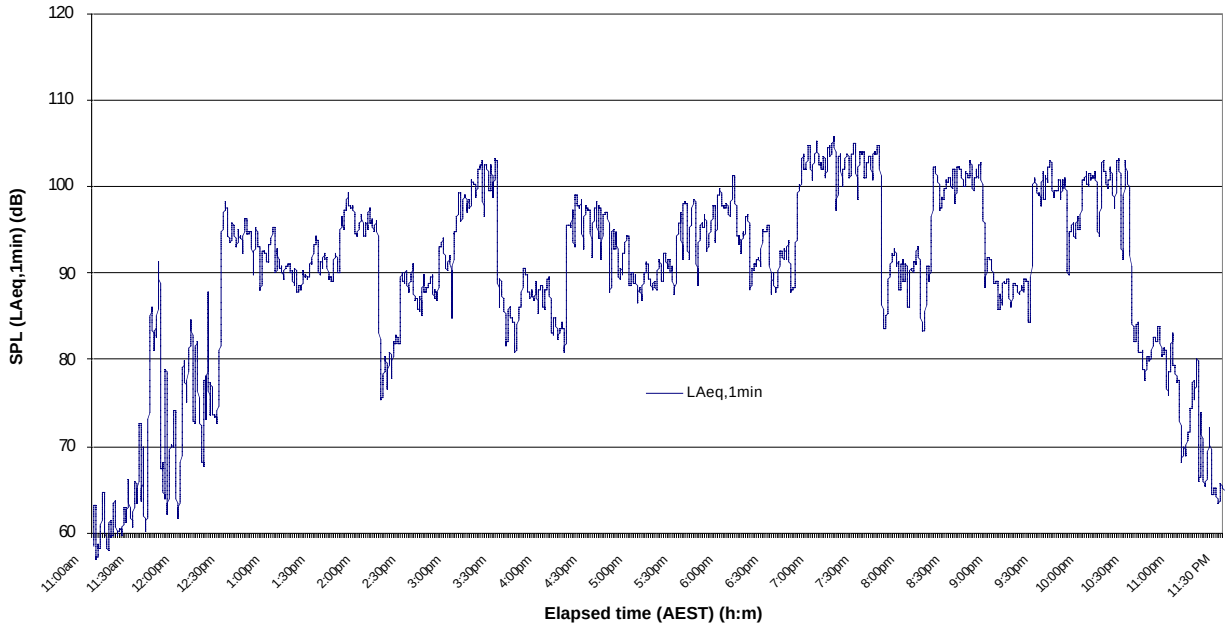

Figure 1: Measured noise levels at a typical outdoor concert over a twelve and a half hour period (Hall: 2007)

Even in 'chill out' areas the average noise level was found to be 92 dB. A recent study by Guo and Gunn (2006) in Western Australia that focused on the noise exposure levels ($L_{Aeq,8h}$) for a range of employees in clubs and pubs found that, in general, noise levels at music entertainment venues are "*excessively high*". They found that the exposure levels for workers ranged from 85 dB for a security person in a bar with only recorded music to 98 dB for a glass collector and manager in a venue with a live band.

Noise level measurements taken at a Sydney 'pub' venue on a typical week night with a live band showed that the L_{Aeq} amongst the audience typically ranged from 102 to 107 dB and hovered around 94 dB on the outside footpath (Williams: 2006). With recorded music as the background between live performances the level was maintained around 83 dB inside the venue. *Figure 1* (Hall: 2007) plots the noise level in the audience for an annual, large outdoor concert. This particular event usually lasts for about four days and the sound systems are set up so that the level is fairly constant over the main audience area.

2.2 Amplified sound in cinemas

Concerns have been expressed in the media about increasing noise levels in cinemas. Movies which rely on special effects are more likely to have the higher noise levels with average levels of 78 dB(A) over three hours being reported for such movies (Hear-it: 2007). With the increase in availability of home cinema and associated high quality sound systems it is possible that there could be more regular exposure to these or higher noise levels during recreation times at home.

2.3 Personal music systems

There has been considerable media coverage of the potential damage to hearing from long term use of personal music systems such as MP3 players, tape players, etc. Typical of these is the warning by the RNID, UK about potential hearing loss from use of personal players, including comments from users about use over long hours and at high sound levels (RNID: 2006). However, much of the concern focuses on the maximum output level and there have been few studies of the noise exposure for typical users. A study by Williams (2004) measured the exposure levels of 55 randomly selected subjects who were using their personal players in noisy public areas in central Melbourne and Sydney. These devices were mainly being used during commuting where the range of background (L_{Aeq}) noise was 71 - 76 dB. The equivalent free field "at-ear" noise level from the player was measured over a two minute sampling period using the level that each subject was listening to immediately before selection. The sound levels ranged from 74 to 110 dB with a mean of 86 dB and reported listening times ranging from 40 minutes to 13 hours per day. From these values the $L_{Aeq,8h}$ were calculated to range from 66 dB to 104 dB while the mean exposure level was 79.8 dB. Twenty five percent of listeners exceeded the 85 dB workplace noise criterion.

2.4 Motor Sports

The noise from motor sport activities often draws considerable media attention, usually related to the noise emanating from the venue or race track into the surrounding area, *i.e.* concern about community/environmental noise. The patrons at the venue can be exposed to noise from general revving, racing, specialist high power vehicles, dynamometer testing and amplified music. Drivers and support crew may well have modern communication helmets that sometimes include hearing protection. On the other hand, patrons are subject to the noise from the output of the vehicle and are often located close to the track to ensure best views.

Specialised high performance vehicles currently have no output noise limits. For other motor sports vehicles the

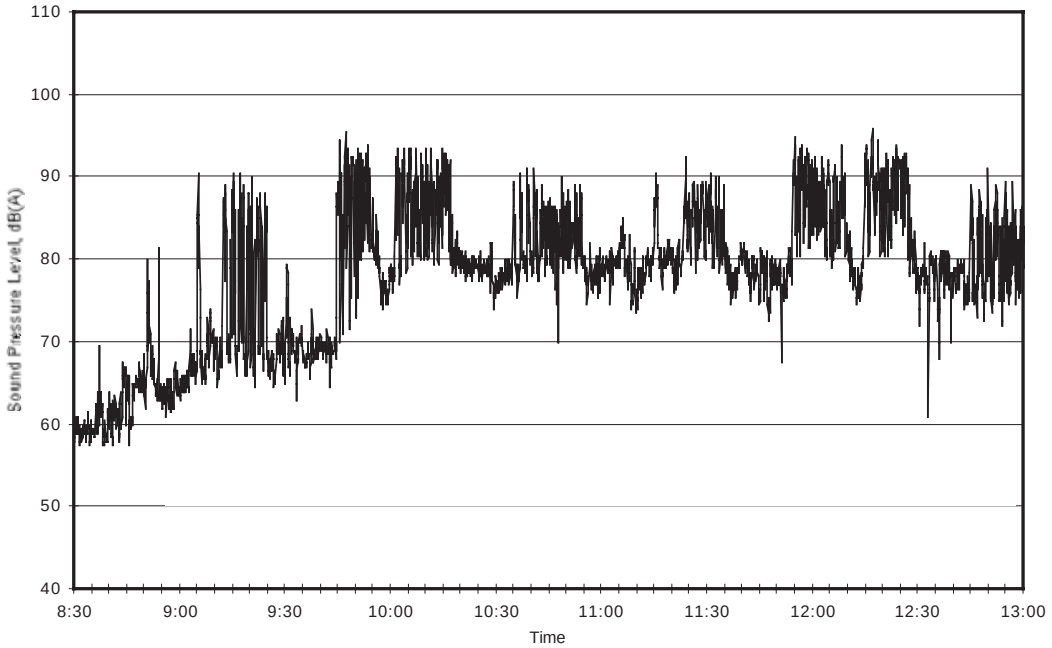

Figure 2: Measured noise levels at the trackside spectator area at a V8 Supercar event over a four and a half hour period (Burgess: 2002)

limiting values have been set with a view to minimising environmental noise impact. In Australia these limits are 95 dB for cars (CAMS: 2004) at 30m, *ie* at the edge of the spectator areas, and 102 dB for bikes at 0.5m from the exhaust (Motorcycling Australia: 2007) under full acceleration. *Figure 2* (Burgess: 2002) shows the noise level variation at the edge of the track during a major event for V8 Supercars. The levels, in terms of $L_{Aeq,5sec}$, were in the 80 to 90 dB range for much of the day.

While acknowledging that some spectators may be exposed to higher levels, it is reasonable to assume that a spectator at a range of motor sports activities could be exposed to an L_{Aeq} of around 90 dB over the time of the event.

2.5 Car Stereo

While the engine noise level inside modern cars has been considerably reduced, custom built stereo systems are becoming common in many vehicles. These usually have very high power and have been found to produce L_{Aeq} up to 104 dB (driver's window open) and are often set well above 80 dB when travelling. L_{Cpeak} levels easily exceed 132 dB with many of the low frequency enhancements in use (Williams: 2006).

2.6 Home Workshop/Garden

Many power tools available for use in the home workshop and garden produce high noise levels and can often be used for long periods. Tools such as portable saws, routers, belt sanders, rotary hammer drills, grinders, chain saws and leaf blowers typically produce noise levels (L_{Aeq}) around 100 dB at the operator ear, while more specialised devices such as staplers and nail guns, utilising impulsive forces, can produce impulse noise levels with a peak (L_{Cpeak}) in excess of 140 dB.

It is very difficult to estimate an typical noise level for home workshop exposure as it is dependent on the tool, the material and the task but it would not be unreasonable to assume an exposure level of at least 85 dB during a couple of hours of activity. For example, the use of a circular saw with an L_{Aeq} of 100 dB for only 15 minutes is equivalent to an exposure level ($L_{Aeq,8h}$) of 85 dB.

3.0 OVERALL EXPOSURE FROM A COMBINATION OF WORK AND RECREATION NOISE

In the previous section, common recreation activities have been shown to have high noise levels. The length of time people are exposed to these recreation noises varies significantly. If the approach as for occupational noise exposure assessment is used to assess the recreation noise exposure, in many cases the $L_{Aeq,8h}$ would be in excess of the recommended 85 dB. If the total noise exposure from the combined workplace noise and subsequent recreation activity noise were assessed, the overall exposure for the individual could be well in excess of the occupational noise exposure criterion.

Two models are presented to investigate the effect of the combination of noisy recreation activities with workplace noise exposure. As there is a requirement to manage the noise in the workplace, these models are based on the noise exposure during the work day not exceeding the exposure standard for $L_{Aeq,8h}$ of 85 dB. The models consider the overall noise exposure from a combination of eight hours of noise exposure below this limiting level plus varying hours for recreational noise at several noise levels. The adjustments from AS/NZS 1269.1:2005 for extended workshifts have been included and hence the steps which occur in each curve when the total exposure time exceeds 10 and 14 hours.

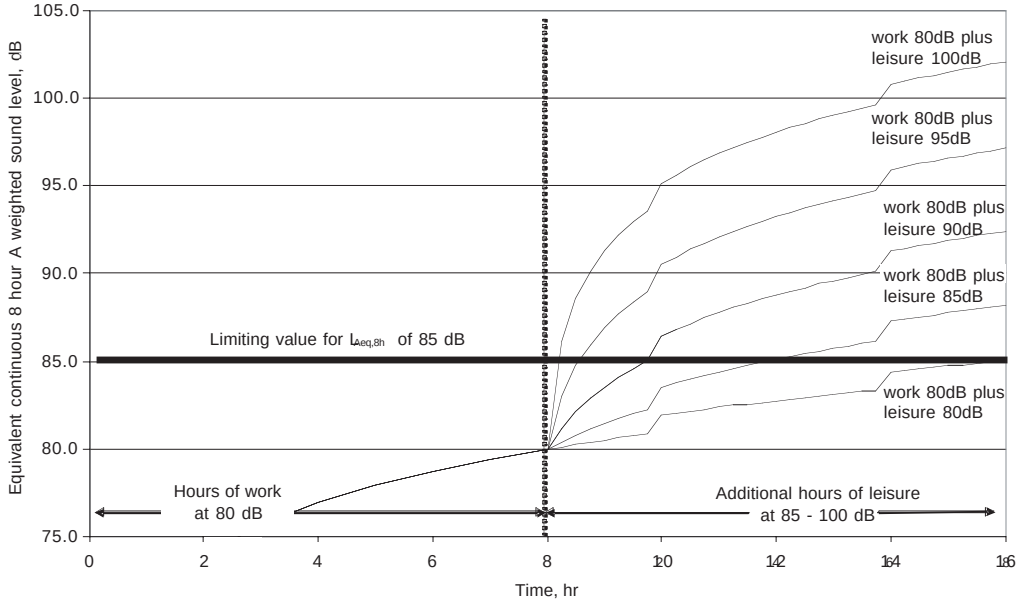

Figure 3: Example of the effect of regularly combining noise from recreation activities after a work day for which the $L_{Aeq,8h}$ was 80 dB.

Figure 3 shows the increasing total exposure over time with various noise levels for recreation activities combined with an eight hour work day where the $L_{Aeq,8h}$ is limited to 80 dB. Hence at the end of the work period the noise exposure level of 80 dB is below the exposure criterion. If this person then spent time each day in recreation pursuits for which the noise levels were less than 80 dB, there would be little concern about exceeding the exposure criterion. If the noise from the recreation activity were equal to the noise level during the work day, *i.e.* 80 dB, a total 16 hour exposure which was a combination of eight hours work plus eight hours of noisy recreation at 80 dB would lead to an $L_{Aeq,8h}$ noise exposure level of 85 dB which is at the exposure criterion. However if the recreation were in a club where the level was 100 dB, the combined noise exposure would exceed the 85 dB criterion after only approximately ten minutes in the club. If a person regularly spends eight hours recreation time in the club at 100 dB, their noise exposure level for the combination of the work day plus the recreation noise would be 102 dB – well above the criterion and with considerable risk of hearing damage.

Figure 4 presents overall exposure where the worker is exposed to a recreational noise of 95 dB and varying controlled levels of exposure at work. Any benefit of controlling the work exposure to 75, 80 or 85 dB is negated by a relatively short recreational exposure. For example, using the lower curve where the work exposure is controlled to an $L_{Aeq,8h}$ of 75 dB followed by the activity with an L_{Aeq} of 95 dB a combined work and leisure $L_{Aeq,8h}$ of 90 dB is achieved after only two hours. It is the exposure to the dominating higher noise level during recreation that takes the noise exposure above the recommended criterion thus negating any benefit from reducing the workplace noise to 75 dB rather than 85 dB.

The strategies for reducing noise exposure during recreation are the same as in the workplace. It is a process of risk management with a hierarchy of controls commencing with the elimination of the hazard as the preferred process, through to the use of personal protective equipment (hearing protectors) as the least preferred.

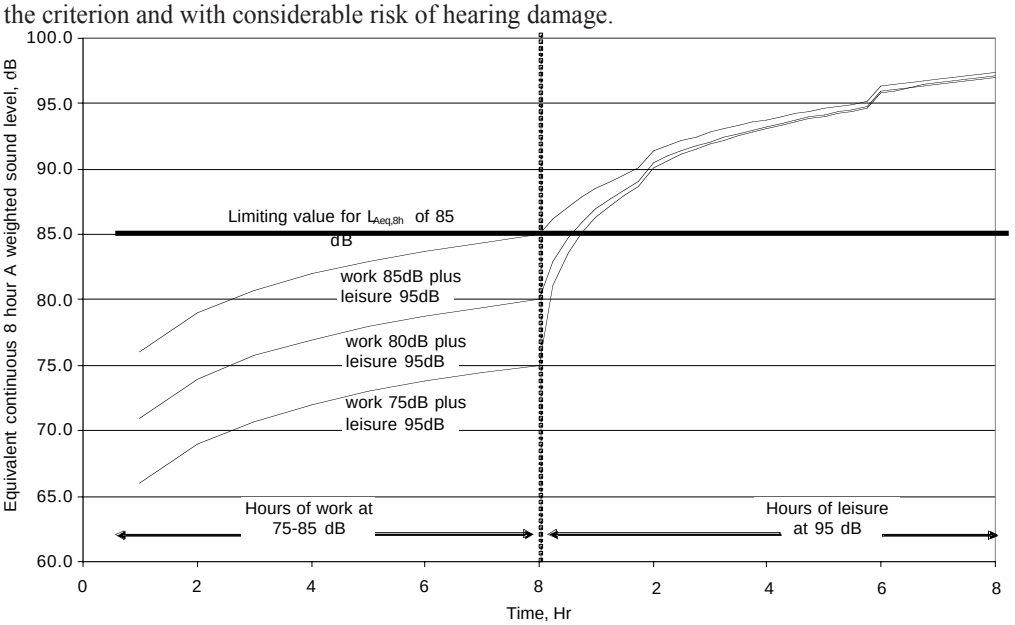

Figure 4: Example showing how the effect of regular exposure to recreational noise with L_{Aeq} 95 dB dominates the combined exposure when workplace noise exposure is below the criterion.

Applying this principle to noisy recreational activities leads to simple actions such as:

- limit the number of visits to noisy venues;
- reduce the volume;
- avoid excessively noisy areas;
- limit the time spent in excessively noisy areas;
- make use of low noise 'chill out' spaces;
- move away from the sources of noise (loud speakers, revving engines, etc.);
- use appropriate, less noisy tools;
- relocate so as not to be within the line of sight of the noise source;
- use appropriate hearing protectors (plugs, muffs, communication devices);
- try to mix less noisy activities with quieter activities.

While individuals are at work, they come under the jurisdiction of various workplace occupational health and safety legislation and codes of practice where responsibilities are well defined for both individuals and organisations. However, when the individuals are away from the workplace, they must be responsible for their own health and safety. In relation to immediate physical dangers this responsibility is usually obvious, but with respect to future health difficulties individuals often do not necessarily know they must act or how to act in their own best interest. This may be due to a number of factors including optimistic bias ("it won't happen to me"), ignorance of the health consequences of their actions or through generally unsafe practices.

4.0 CONCLUSION

In the workplace, regulations require the implementation of noise management strategies with the goal to ensure no workers have noise exposure levels, $L_{Aeq,8hr}$, greater than 85 dB or peak levels, L_{Cpeak}, greater than 140 dB. For recreational noise exposure, there are no legally binding noise exposure criteria. However, popular recreational activities have been shown to produce noise levels, L_{Aeq}, well in excess of 85 dB.

The combination of time spent in a controlled workplace, where the exposure does not exceed the regulation, plus time spent in a noisy recreational activity can lead to an overall noise exposure that may be considered as posing a risk to hearing health. To minimise the risk of hearing loss from such activities, individuals must take responsibility and minimise or control their exposure to excessive recreational noise. Simple strategies, similar to those for mitigating workplace noise exposure, can be applied in recreational pursuits and in many situations this will require a change in both attitude and behaviour of all those involved with the recreational activity.

5.0 ACKNOWLEDGEMENTS

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