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A snapshot of young adults' noise exposure reveals evidence of 'Binge Listening'

Elizabeth Francis Beach [a,*], Megan Gilliver [a,b], Warwick Williams [a,b]

[a] National Acoustic Laboratories, Macquarie University, New South Wales, Australia
[b] Hearing Cooperative Research Centre, Melbourne, Victoria, Australia

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ABSTRACT

There have been several previous studies into daily noise exposure levels in modern urban communities, which typically report mean noise exposure levels (L_{Aeq}) for adults between 73 and 79 dB. In this study, rather than focus on group mean exposures across a wide age range, individual patterns of noise exposure over 4- and 5-day periods were examined in a group of 45 young adults aged 18–35 years. The main objective of the study was to determine the extent to which young adults exhibit a 'binge listening' pattern of noise exposure, i.e., high weekend leisure noise vs. low weekday work noise exposure. A secondary objective was to identify the types of activities that generate the highest noise exposures. The results showed that although most participants (60%) were exposed to low daily noise levels, 33% of participants exhibited a 'binge listening' exposure pattern characterized by one or two high-noise days, usually a Friday, Saturday or Sunday, preceded or followed by much quieter days. The most notable high-noise activities were playing an instrument solo or in a band; attending a nightclub; and attending a pop concert, each of which recorded average noise levels greater than 100 dB. Future research is needed to determine whether 'binge listening' is more or less harmful than the chronic exposure presupposed in traditional risk models, however, under the equal-energy principle, repeated 'binge' noise exposures from weekend visits to nightclubs, live music events and other high-noise events represent a significant risk to long-term hearing health.

1. Introduction

The daily noise exposure of individuals in the community has been measured by researchers since the late 1970s. The aim of these studies has been to determine typical noise exposure levels of individuals in modern urban environments, and whether such noise levels pose a risk to hearing health. The studies have also been used to identify which activities emit the highest noise levels, and which members of society (in terms of age, gender, and occupation) are exposed to excessive noise and are therefore at risk of noise-induced hearing loss (NIHL) and other noise-related effects.

In Johnson and Farina's [1] epic study, a male medical technician wore a noise dosimeter for 31 days. His daily A-weighted noise exposures ($L_{Aeq,24h}$) were quite low, ranging from 59 dB to 83 dB per day, with a daily average of 76 dB. Seventy percent of the total noise exposure was from events that occupied less than 7% of the wearer's time. The noisy activities were parties, nightclubs, outings to a bowling alley, and a 'car hobby shop'. Although this case study was not intended to provide representative data for the community, it established personal noise dosimetry as a reliable methodology which has been adopted by researchers in the field ever since.

Since then, a number of dosimetry studies have examined daily noise exposure in children and adults in the US, Japan, China, and Spain [2–11]. Most of these studies have reported average noise exposure results ($L_{Aeq,24\,h}$ or $L_{Aeq,8\,h}$) that were often higher than the recommended daily EPA limit of 70 dB $L_{Aeq,24\,h}$/75 dB $L_{Aeq,8\,h}$ [12] but usually less than the most widely used occupational standard of 85 dB $L_{Aeq,8\,h}$ [e.g., 11,13].

The broader scope of these studies has allowed investigation of the exposure patterns of different groups. Where gender differences have been examined, males have tended to have higher noise exposures than females [9,10,13]. The few studies which found a relationship between age and noise levels, found more noise exposure amongst younger than older participants [2,6,11], and those studies that focused on children [8,10] reported higher average daily noise levels than all of the adult studies.

No clear pattern emerges as to the relative contribution of occupational versus non-occupational (or leisure) noise. Although occupational noise was found to be more significant than leisure noise for a group of (mostly male) US construction workers [4,14], the

* Corresponding author. Address: Australian Hearing Hub, 16 University Ave, Macquarie University, NSW 2109, Australia. Tel.: +61 2 9412 6983; fax: +61 2 9412 6769.
E-mail address: elizabeth.beach@nal.gov.au (E.F. Beach).

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opposite was true for Spanish adults with a mix of occupations who experienced most of their noise (64.6%) during the 4.5% of the time spent participating in leisure activities [2]. In contrast, occupational noise accounted for 61% of daily noise experienced by Chinese adults with a mix of occupations [3]. These varying results suggest that the relativities between leisure and occupational noise are not straightforward and are highly dependent on the particular occupational and leisure activities of individuals.

In those studies where noise exposure was measured over several days, researchers have been able to examine whether certain days of the week were more or less noisy than others. Two studies compared the average daily noise exposures of their entire samples and found no significant differences between average noise levels on different days of the week [11,13]. However, Diaz and Pedrero [2] examined this question as a function of age and found a striking pattern. In their young adult group (17–25 years), there was a large peak in noise exposure on weekends (Fridays, Saturdays and Sundays), such that 76% of their weekly noise exposure was received during weekend leisure activities, such as attending nightclubs and discotheques. This contrasted with adults aged between 25 and 73 whose noise exposure was more evenly distributed throughout the week.

The aim of the current study was to examine individuals' patterns of daily noise exposure in a similar sample of young Australian adults aged 18–35 years. It was hypothesized that noise exposure in this group would reveal a similar pattern to that found for under-25s in the Diaz and Pedrero [2] study. Because young adults are more likely to engage in high-noise leisure activities such as nightclubs and live music events [15,16], which tend to occur at the end of the week, higher weekend than weekday noise exposures were anticipated. Moreover, in a pilot study of nine young adults, six showed this pattern of high weekend leisure noise vs. low weekday work noise exposure – a pattern which came to be called 'binge listening' [see 17]. This pattern of exposure is of particular interest because it is unknown whether 'binge' episodes of high noise exposure are more or less harmful than the lower, but more constant, levels of noise exposure assumed in occupational noise exposure risk modeling [e.g., 18]. The equal-energy principle implies that higher noise exposures of shorter duration are equivalent to lower noise exposures of longer duration, but it may be that recovery time between exposures ameliorates some of the risk associated with episodic high-noise exposures.

In the current study, 45 young adults wore dosimeters to obtain a snapshot of their noise exposure. Noise exposure was measured over a 4- or 5-day period, and participants kept a written diary of events and activities during this period. The objectives of the study were to (i) determine the extent to which 'binge listening' occurs amongst 18–35-year-olds; and (ii) identify the types of activities that generate the highest noise exposures for this group.

2. Materials and methods

Ethics approval for this project was obtained through the Australian Hearing Human Research Ethics Committee. Daily noise measurements were gathered using CEL-350 dBadge Personal Sound Exposure meters from Casella-CEL (Bedford, UK), which were calibrated prior to use with a CEL-110 Acoustic Calibrator. The dosimeters have a frequency range of 30–12,000 Hz and logL_{Aeq} between 65 and 140 dBA in one-minute intervals. Dosimeters were worn continuously by participants for 4- or 5-day periods. The measurement periods were chosen to represent exposures that individuals may receive during a typical week from both occupational and leisure activities. The measurement periods included Friday, Saturday and Sunday in order to gather information on the full range of leisure activities that may be experienced during participants' typical non-work hours. Prior to commencing the study, participants were shown how to use the dosimeters. They were instructed to attach the dosimeter to their clothing, usually the lapel, for all waking hours, except for water sports or body contact sports where participants were advised to place them as close by as possible. During sleep periods, the devices were attached to a battery charger for recharging and thus noise measurements were not carried out during this time.

Participants were asked to complete a daily diary record of activities and events experienced at the end of each day. They were provided with several blank diary pages with a grid for entering details under the following headings: date, time period, brief description of activity, location, sources of noise, number of people in immediate area, location of dosimeter if not on lapel, and a subjective loudness rating. The data pertaining to the loudness ratings have been reported in an earlier paper and will not be discussed further here [see 19]. Participants were required to account for the entire day, and they were asked to start a new entry whenever their environment changed, e.g. a day during which several different activities occurred was to be entered as a series of separate events/activities, e.g. (1) lunch, (2) bushwalk, (3) cafe, etc.; and a single evening may have been recorded as: (1) dinner, (2) pub with mates, (3) same pub with live music.

2.1. Participants

Participants were volunteers recruited through social-network internet sites, individuals known to researchers, and work colleagues using a 'snowball' recruitment method. In total there were 45 participants aged between 18 and 35 years with most participants living in Sydney ($n = 42$), and three from rural areas. All participants received a department store gift voucher valued at $100 for their participation. Data from three participants were discarded because either the diary ($n = 1$) or the noise recordings ($n = 2$) were incomplete.

The education levels of the final sample of participants were high: 62% held a university degree, (which is more than double the 28% of 20–34-year-olds in Australia who currently hold a degree [20]; 14% had obtained a vocational qualification; and the remaining 24% held a school qualification only. Eleven participants were students, three of whom were studying music. The remainder were employed as business and information professionals ($n = 8$), health professionals ($n = 7$), education professionals ($n = 7$), in trades and related roles ($n = 5$), administration ($n = 2$), or home duties ($n = 2$). In addition to the three music students, two of whom were employed part-time in the music industry, a fourth participant was an amateur musician, who played in a band.

2.2. Data analysis

A total of 39 participants (93%) recorded data for 5 full days, while the remaining participants completed four days. At the conclusion of each participant's measurement period, dosimeter results were downloaded using supplied software with International Organization for Standardization (ISO) protocols and definitions. Each participant's dosimeter output and diary were compared and any incomplete or ambiguous diary entries were identified. Individual post-test interviews were held with all participants and where necessary, participants were asked to provide additional details to ensure that each diary entry was as complete and accurate as possible. All L_{Aeq} peaks ($n = 23$) that were a result of interference such as 'accidentally knocking the dosimeter' or were 20 dB or greater than the adjacent peaks were excised before any noise calculations were performed.