Preschool teachers’ exposure to classroom noise

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This research examined exposure to classroom noise of 25 full-time teaching staff in 14 preschool settings located across Western Sydney. The results indicated that one teacher exceeded the maximum permissible level of daily noise exposure for employees under the health and safety legislation. Three staff approached this level and 92% of teachers were subjected to daily noise exposure which, if occurs repeatedly, is considered potentially harmful. Nine staff recorded peak noise rates in excess of the permitted limit. High levels of noise were evident when large numbers of students were located in confined areas, when they were involved in rough play or were distressed, when the students dropped heavy play equipment, and during music sessions. Further research on noise in early educational settings across different nations appears to be valuable for understanding both the scope of the problem and possible remedies.

Introduction

In recent years a number of studies have been carried out to examine the issue of noise in early childhood educational settings (e.g. Maxwell & Evans, 1999; Baxter, 2000; Nelson & Soli, 2000; Sorkin, 2000). Most of these projects have focused on students’ health, and psychological and educational impairments created by classroom noise (Evans & Lepore, 1993; Evans & Maxwell, 1997; Nelson & Soli, 2000). However, McLaren and Dickinson (2002) have found that exposure to noise is also a problem amongst early childhood teachers, with 30% being exposed to noise in excess of the maximum permissible level under New Zealand standards.

The Australian standard for exposure to noise in the occupational environment is consistent with that enacted in New Zealand: 1.0 (Pa2H), or an average of 85 decibels (dB(A)) for an eight-hour day, and 140 dB(C) for peak noise level. It is

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important to note that these levels specify maximum permissible exposure within the workplace. Repeated exposure to lower levels of noise such as 75–80 dB(A) may also cause hearing damage over the longer term (American Speech–Language–Hearing Association, 2004; National Occupational Health and Safety Commission, 2000).

In addition to the physical damage caused by exposure to excessive noise, continued exposure has been associated with elevated levels of stress, high anxiety, increased annoyance, depression, and fatigue (Glass & Singer, 1972; Kryter, 1994; Doherty, 1999; Evans & Johnson, 2000; Kalveram, 2000). Stress, in turn, has been observed as contributing to a number of psychosomatic conditions, including asthma, digestive tract disorders, heart diseases, migraines, and chest and back pain (Galloway et al., 1984b; Maddi & Kobasa, 1984; Wilder & Plutchik, 1984; Bacon et al., 1994; Donoghue & Siegel, 1994; Doherty, 1999). Hans Selye, whose research first demonstrated that the continuing presence of stressors modified the immune system, labelled these conditions ‘diseases of adaptation’ (Selye, 1956). Unsurprisingly, stress has been shown to disrupt both workers’ performance (Evans & Johnson, 2000) and their job satisfaction (Galloway et al., 1984a).

The framework used here is essentially drawn from the most common understanding of noise as ‘any undesired sound’ (American Heritage Dictionary of the English Language, 2000; Concha-Barrientos et al., 2004). By extension, noise can be considered sound that one would generally prefer to avoid. Thus, occupational noise is undesired sound in the workplace, and it is associated with some activities more than with others. In this sense, occupational noise is more likely to adversely affect an individual than environmental noise of comparable level (e.g. traffic, sports, music), simply because common noise sources are relatively occasional and avoidable, while occupational noise is inescapable in some workplaces, and employees have to endure it for many years on a daily basis. Besides, we should keep in mind that workers in noisy environments are subjected to common, unrelated to job noises like everyone else, so it is occupational noise that makes all the difference. Even moderate levels of occupational noise are reported to result in higher levels of stress and lower task motivation (Evans & Johnson, 2000). Furthermore, in learning and teaching situations noise affects well-being and performance of teachers and students both indirectly, through stress, and directly by disturbing teacher–student and student–student interactions (McLaren & Dickinson, 2002).

Some would say that the perception of a particular sound as noise may vary across people; for example, children playing may be ‘music’ to one ear and noise to another. With respect to this view, teachers in this study were asked to name the main sources or causes of noise in their classrooms, and none of those sources appeared to be of an enjoyable or at least an ambiguous nature.

Anecdotal evidence suggests that much of employee ‘burnout’ and turnover in the Australian early childhood workforce can be attributed, at least in part, to job strains and the nature of the environment. For example, working conditions and the intensity of the workplace were cited by the respondents to a New South Wales (NSW)
Childcare Workers’ survey as their second most significant concern following wages (Warrilow et al., 2002). Many teachers appear worried about the impact of noise on their hearing, as they often report going home with ‘ringing ears’. Indeed, school boards are becoming increasingly concerned about the relationship between noise and the performance of both teachers and their students.

Thus, the principal concern of this research was to look at an under-studied group of professionals at risk, with a focus on their exposure to occupational noise. It was expected that a number of full-time teachers might be subjected to noise close to the maximum levels permitted for employees under the Australian Occupational Health and Safety (OH&S) legislation.

**Method**

*Participants*

Data were collected from 25 full-time teaching staff located at 14 preschools across Western Sydney and operated under the auspices of the New South Wales Department of Education and Training. Full-time employees were selected for monitoring since it was assumed that this group would experience noise over relatively longer periods than other staff (McLaren & Dickinson, 2002). Of the participants, all were female. Their mean age was 42.7 years (SD = 9.7), and they had accumulated an average of 13.9 years (SD = 8.5) of teaching experience. Student:teacher ratios were 10:1 for 16 participants (64%), 11:1 for two participants (8%), and 12:1 for seven participants (28%).

*Noise assessment*

The assessment of the daily noise exposure for full-time teaching staff was based on an average eight-hour equivalent sound pressure level, and peak sound pressure level. The ambient noise level was monitored using a high-quality personal ‘Casella’ sound exposure meter, model CEL-310/K1, which is designed to meet the standards of the *National code of practice* (2000). The data collected included:

- LAeq (A-weighted average sound pressure level throughout a trial period);
- LEP,d or LAeq,8h (daily equivalent sound level, i.e. LAeq projected over eight hours);
- dose% (the amount of actual exposure relative to the amount of allowable exposure for which 100% and above is hazardous);
- Pa²H (exposure displayed in Pascal units);
- LCpeak (peak sound pressure exceedence);
- event and time history.

The estimation of noise level, projected over eight hours, was provided by the instrument. It standardized the exposure received by the teachers during the approximately six hours of actual working time, assuming that the remainder of
the eight-hour reference period was quiet. This allowed adequate comparisons of
the individual exposure rates with each other and with the OH&S eight-hour stan-
dard. For example, if a teacher received 85.8 decibels during the six-hour work-
day, this value was projected over eight hours, assuming that the remaining two
hours were quiet, hence the average value dropped down to 84.6 decibels (see
Figure 1).

In having a non-experimental descriptive design this research aimed to identify the
status of a particular variable (noise exposure) for a single sample. Therefore, no

![Figure 1. Recorded and projected noise exposure. Peak noise exceedence](image-url)
control or comparison group was employed. An issue of relevant comparison data is raised in the Discussion section.

Procedure

The preschools were visited to monitor participants’ noise exposure and to keep a log to relate the data to actual sounds and activities. Each teacher was monitored for one day. Measurements of noise exposure were conducted by fitting a personal sound exposure meter (dose badge) to staff members for the duration of their working day. The badges were first calibrated and activated by a reader unit and then pinned to clothing near the ear of the teacher. Staff noise exposures were logged automatically by these means starting from 8.45–9.00 a.m. when direct supervision began, throughout morning sessions (9.00–11.30 a.m.), lunch breaks, afternoon sessions (12.30–3.00 p.m.), and ending at approximately 3.15 p.m. when all students were picked up. This totalled 5–5.5 contact hours and about six hours of monitoring time overall. The monitoring was conducted on regular, ordinary days in the absence of any special events or outings. The participants also completed a background data sheet that, apart from the demographic details, contained a multiple-response, open-ended question concerning the main sources or causes of noise in their classrooms. The respondents were not asked to rate these sources. This additional question was considered valuable for future research initiatives.

Results

Of the 25 preschool teaching staff monitored, the highest individual noise exposure levels were 85.0, 85.1, 85.8, and 86.1 dB(A) during the six-hour workday. These values were projected over eight hours, assuming that the remainder of the eight-hour reference period was quiet, and resulted in daily equivalent exposures of 84.1, 84.2, 84.6, and 85.3 dB(A), respectively. This estimation was calculated automatically by the sound exposure meter. Thus, one teacher exceeded the Australian OH&S limit of 85.0 dB(A) and three staff approached this limit. These exposures corresponded to 70–103% of the noise dose that is considered harmful. Nine staff recorded peak noise rates that exceeded the maximum permissible level of 140 dB(C) for peak noise. In total, 10 of the staff evaluated were subjected to noise beyond the maximum acceptable levels under Australian standards. Twenty-three teachers were subjected to daily noise exposure over 75 dB(A). In the process of monitoring it was found that the peak noise exceedence recorded by the badge was sometimes due to bumping the microphone which gave false results. Consequently, five of the fourteen peak noise exceedence cases inconsistent with the observations and time histories data were discarded. The other nine cases were considered legitimate based on high general levels of noise when peak exceedence occurred, especially when the records were consistent with the observations—for example, while a staff member was comforting a distressed student screaming close to the ear of the teacher (see Figure 1).
The lowest levels of noise exposure recorded amongst all of the preschools were 73.9 and 74.3 dB(A) over an eight-hour equivalent period, or 6% and 8% of the maximum noise dose, respectively. In each case, the students were put to sleep for 1–1.5 hours after lunch, while the teachers moved to another room, completing paperwork and overlooking the students through a window. Table 1 shows the descriptive statistics relating to these findings for all participants, and also for the subsamples of teachers whose average daily noise exposures were under and above 80 decibels. This distinction was made based on the American Speech–Language–Hearing Association stating that sounds louder that 80 dB(A) are potentially hazardous (American Speech–Language–Hearing Association, 2004).

The log of events and activities associated with the measurements showed that the highest levels of noise were recorded when a large number of students were located in a confined space such as the free-play area, when they were fighting over playthings, or when the students were involved in rough play. High levels of noise were also evident when students were distressed, when they dropped heavy play equipment, and during music time, when the students were playing instruments. From the teachers’ perspective, the main causes or sources of noise (most teachers recorded more than one source) in their classrooms included:

- poor weather, which kept students indoors (10, 20.8% of all responses);
- insufficient space, such as a confined indoor area (8, 16.6%);
- a resonant floor, furniture, and/or play equipment (e.g. wooden blocks) (6, 12.5%);
- distressed students (6, 12.5%);
- outside noises from traffic or a nearby school (5, 10.4%);
- students with behaviour problems or over-exuberant (4, 8.3%);
- noisy indoor activities (e.g. assemblies, music, bells) (4, 8.3%);
- air conditioners (4, 8.3%);
- alarms sounding on exit doors (1, 2.1%).

The time histories also suggested that afternoon sessions were generally as noisy as morning sessions, and that noise levels did not always decrease during lunchtime. Anecdotal reports from two staff revealed that the staff rooms where they had lunch were as noisy as the classrooms (cf. Figures 1 and 2). Both figures depict single cases.

<table>
<thead>
<tr>
<th>Noise parameters</th>
<th>Overall group</th>
<th>High-exposure subsample</th>
<th>Low-exposure subsample</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(N = 25)</td>
<td>(n = 12)</td>
<td>(n = 13)</td>
</tr>
<tr>
<td>Recorded dBA</td>
<td>M = 80.5, SD = 3.2</td>
<td>M = 83.6, SD = 3.5</td>
<td>M = 77.8, SD = 4.3</td>
</tr>
<tr>
<td>Projected (standardized) dBA</td>
<td>M = 79.4, SD = 3.2</td>
<td>M = 82.2, SD = 1.9</td>
<td>M = 76.9, SD = 1.7</td>
</tr>
<tr>
<td>Dose%</td>
<td>M = 33.3, SD = 25.7</td>
<td>M = 53.2, SD = 23.8</td>
<td>M = 14.8, SD = 6.1</td>
</tr>
<tr>
<td>Peak sound exceedence cases (%)</td>
<td>9 (36.0)</td>
<td>6 (50.0)</td>
<td>3 (23.1)</td>
</tr>
</tbody>
</table>
Figure 2 shows a sharp decrease in sound level between 11.45 a.m. and 12.30 p.m. corresponding to the participant’s lunch break in a quiet setting, whereas Figure 1 does not show an expected similar reduction, since the participant had lunch in the staff room. It was also interesting to note two obvious drops in noise level between 10.10 a.m. and 10.40 a.m., and also between 2.40 p.m. and 3 p.m. (see Figure 1), consistent with the outside play periods, and the absence of such drops (see Figure 2) in those cases when students had to stay indoors as a result of poor weather. Furthermore, Figure 2 demonstrates some increase in noise levels around unused outside times, and this increase is not related to any apparent reason or activity. According to the teachers, such an increase may result from students’
frustration; however, this study did not collect enough comparative data to support this assumption.

Discussion
The aim of this study was to explore the extent of classroom noise in preschool facilities of Western Sydney in relation to the Australian OH&S standard. The results revealed that one teacher exceeded the daily limit of 85.0 dB(A) eight-hour equivalent, and nine staff exceeded the 140 dB(C) limit for peak noise level. Three staff recorded values that approached the OH&S daily limit, and 23 or 92% of teachers were subjected to daily noise exposure over 75 dB(A) eight-hour equivalent. According to the National code of practice, if exposure to these noise levels occurs repeatedly, it may have adverse effects on some workers.

This outcome should not be considered conclusive, since a convenience sample of a limited size was investigated. Nevertheless, two facts support extrapolation of the findings to a sizeable proportion of Western Sydney early education facilities. First, the sample was derived from schools of diverse size and socio-economic characteristics distributed across an area of approximately 160 km². Second, anecdotal reports from many teachers revealed that the monitoring days were quieter than usual, and no one suggested otherwise. Conducting more than one monitoring session per participant may be useful in future studies.

A comparison between these outcomes and levels of noise recorded for other occupational groups or the population in general is more complicated than may seem. An analysis of the literature reveals that most research on occupational noise is focused on activities associated with particularly high levels of exposure, such as manufacturing, transportation, mining and construction. Referring to such research data in this study would not be quite valid, as workers in high-risk environments normally wear hearing protectors, which is not possible for preschool teaching staff. Additionally, all currently available personal sound exposure meters are not sensitive to low and moderate levels of noise, thus limiting opportunities to obtain full range of comparison data. Two recent studies, however, provide interesting and similar data on school music teachers’ sound exposure (Eaton, 2001; Behar et al., 2004). For example, Eaton (2001) reports that from 81.9 to 91.1 dB(A) eight-hour equivalent was recorded by full-time school music teachers, and from 78.1 to 79.9 dB(A) by part-time staff. The average exposure was 85.5 dB(A) eight-hour equivalent (SD = 3.8). This was compared to the average daily sound exposure of 76.0 dB(A) for teachers in English/social classes, which was largely teachers’ own speech. These findings compared to the present research outcomes may imply that preschool teachers are subjected to lower sound rates than school music teachers, but to higher rates than other teaching professionals. In particular this refers to full-time preschool teachers, half of whom exceeded the average daily exposure of 80.0 dB(A).

Importantly, the results that were obtained in the present study were consistent with the results of a similar study in New Zealand (McLaren & Dickinson, 2002). Therefore, it might be argued that the results reflect a much broader issue across
developed nations in which early childhood education is an established practice. Further research on noise in all types of early educational settings, and across different nations, may be valuable in understanding both the scope of the problem and possible remedies. For example, spacious open-roofed verandas available in some schools allow students to play outdoors even in rainy weather, a larger per-person area in the classroom might help avoid crowding and conflicts and thereby reduce noise. Sound-absorbing flooring, acoustic ceilings and windows, sound dampers on furniture legs, and careful selection of low-noise play equipment could make a considerable reduction in noise to the benefit of both staff and students. Some of these measures would be less costly than others and could easily be put into effect at the school level, while others may require policy decisions.

There are several limitations in the study. First, the small size and convenience character of the sample may have impacted the reliability of the outcomes. Second, the data on noise were obtained by means of a single monitoring session per participant during one school term, and thus may not reflect typical individual exposures. Finally, only one type of early educational facility, allegedly the ‘quietest’ one, was investigated. Nonetheless, the research has generated important pilot data, providing the basis for a broader study in order to understand and manage classroom noise as an integral issue in early childhood education. This could include regular monitoring of teaching staff in all types of early educational settings, and further investigation of all aspects of noise in these facilities including per-person space in the classroom, the design of premises, furniture, ventilation, heating, and some educational trends.

Considering educational trends which might require some revision, New Zealand researchers highlighted music sessions with amplified music and the use of percussion instruments such as clackers or claves (S. McLaren, personal communication, June 2005). It was noted that if the instruments were made of an alternative material such as plastic (to reduce the sharp impact-type sound), they would still give the desired musical benefit. It was also argued that music sessions could be held with smaller groups of children which would have the increased benefit of not producing so much sound, and would encourage students to enjoy and appreciate music without becoming accustomed to its being excessively loud.

References


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