Assessment of Occupational Personal Sound Exposures for Music Instructors

Kathryn J. Crawford and T. Renée Anthony
Department of Occupational and Environmental Health, The University of Iowa

Background

Exposure to high noise levels (>85 dBA) may lead to adverse health effects including tinnitus and hearing loss.

Few research studies have comprehensively examined this exposure in music instructors, but limited data identify a risk of excessive sound exposure.

Music instructors are required to listen acutely to student performances. Thus, any auditory disorder could be especially detrimental to their careers.

Due to inherent variability in music and daily tasks, it is difficult to estimate occupational exposure by sampling for one day.

Objectives

1) To characterize sound exposures for music instructors by instructional area, determining the prevalence of exposure above the 85 dBA time-weighted average (TWA) NIOSH recommended exposure limit (REL)

2) To quantify the contribution of work tasks to daily dose

Methods

Faculty and graduate teaching assistants employed at the University of Iowa School of Music were invited to participate.

Participants were trained on how to wear and use the dosimeters and how to complete an activity log recording work-related tasks throughout the day.

Task categories were determined in preliminary interviews and discussed with participants before and after sampling.

Weekly activities were discussed prior to sampling and logs were reviewed upon completion to help classification.

Table 1. Example of partial activity log given to participants

Time	Activity	Notes
9:00-9:30 am		
9:30-10:00 am		

Personal sound exposure measurements were collected:
- Full shift, 4 -7 days in a row
- Over two randomly selected weeks
- Using Casella dBadge 2 Pro dosimeters (Bedford, UK)

Dosimeters were set to measure sound equivalent level (LEQ):
- Slow response
- A-weighted, no threshold
- 1-second logging

Calculations

LEQ data were processed to compute daily dose, and task-specific contributions to dose using NIOSH / ACGIH criterion (85 dB criterion level, 3 dB exchange rate), using a modified 70 dBA threshold, by computing:

T_n=time allowed, seconds, at each 1-second LEQ measured:

$$T_n = \frac{28{,}800\ seconds}{2^{\left(\frac{LEQ-85}{3}\right)}}$$

Dose, using C_n= number of seconds exposed at given LEQ:

$$Dose = \sum \frac{C_n}{T_n} = \sum \frac{1\ second}{T_n}$$

Eight-hour time-weighted averages (TWA):

$$TWA = (10 * \log_{10} Dose) + 85$$

All data were coded in Microsoft Excel (Redmond, WA). Descriptive statistics and distributions were analyzed using SAS 9.4 (Cary, NC), both over all participants and by task and instructional area.

Results

Twelve participants in six instructional areas participated:
- Brass, conducting, music education, strings, voice, and woodwinds

110 TWAs were measured:
- Range: 61 dBA to 95 dBA
- Normally distributed: mean = 80 dBA, stdev= 7 dBA
- 25% of TWAs > 85 dBA REL

For all instructional areas *except* music education, at least one 8-hour TWA exceeded 85 dBA.

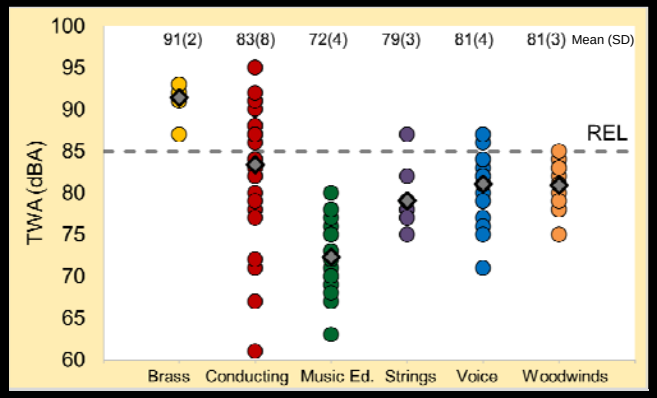

Figure 1. TWAs by instructional area. Gray diamonds indicate area mean; numbers above indicate area mean and standard deviation in dBA. The dashed line indicates the 85 dBA NIOSH REL.

Results

Table 2. Summary of task-specific dose percentages and durations

		Dose Percentile, %			Minutes per task	
Task	N	5th	50th	95th	Mean	Stdev
Band Supervision	5	0.7	9.3	197.9	62.3	39.2
Class	61	< 0.1	1.3	13.7	85.2	25.6
Group Rehearsal	75	1.2	39.2	329.8	100.5	45.2
Lesson	182	0.3	5.2	29.8	43.7	26.2
Meeting	44	0.1	0.4	5.7	64.7	41.3
Office	175	<0.1	0.4	8.3	74.3	61.6
Performance	12	1.9	88.1	630.9	102.1	72.3
Personal Practice	45	0.4	27.7	118.4	39.8	18.9

The 100% daily dose was exceeded in the following tasks, which lasted from 30 minutes to 240 minutes each:
- 50% of performances
- 40% of band supervision tasks
- 20% of group rehearsals
- 7% of personal practice sessions

Conclusions

Music instructors working in brass and conducting had 8-hour exposures above 85 dBA on 100% and 48% of study days, respectively.

Music instructors in other areas may still be at risk of overexposure depending on their scheduled activities.

Controls are needed to reduce sound levels during group rehearsals, performances, and personal practice sessions.

Future Work

This study is ongoing, and data are being collected over an additional semester to fully assess variation in teaching activities over an academic year.

Future work will evaluate a combination of work-scheduling, engineering controls, and PPE use to determine options to reduce exposures to this group of highly variable exposures.

Acknowledgements

This research was supported by a pilot project research training grant from the Heartland Center for Occupational Health and Safety at the University of Iowa. The Heartland Center is supported by Training Grant No. T42OH008491 from the Centers for Disease Control and Prevention/National Institute for Occupational Safety and Health.