Sound pressure levels during amplified orchestra rehearsals and performances

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INTRODUCTION

Sound levels in orchestra settings have been reported to vary greatly as a function of position in the orchestra, performance hall acoustics, type of music, and whether the measures are made during rehearsals or performances. In some cases, sound levels have been reported that are high enough to be of potential risk to performers' hearing. However, the duration of performances and rehearsals may be short enough to not pose a serious hearing hazard[1].

Measures of hearing loss in orchestral musicians has demonstrated that many musician show signs of noise-induced hearing loss following many years of music exposure[1,2]. The amount of loss as measured by pure-tone thresholds is extremely variable, like all noise-induced hearing loss, but in general is mild and restricted to frequencies around 4000 Hz.

A noise exposure survey was conducted at the request of members of a professional orchestra, who were concerned about sound exposure levels during some performance situations. The orchestral members were most concerned by the sound levels during certain performances in which electrically amplified instruments were being used. Some performers reported having increased difficulty hearing their own instruments while performing, and having symptoms of excessive noise exposure (tinnitus and dulled hearing) after some performances.

METHOD

A noise survey was conducted over a period of five months in the primary performance hall of a professional orchestra. Sound measures were made during both rehearsals and performances. The music included country and pop musical styles. Many of the performances included the use of amplified instruments.

A Bruel & Kjaer model 2231 sound level metre with integrating module BZ 7100 and a type 4155 microphone were positioned on the performance stage at several locations adjacent to performers' shoulders. Sound measures were made during a sample of musical pieces and during the musical breaks. All measurements reported here are based on 10-minute measurement intervals with A-weighting and the fast measurement setting.

RESULTS

Sound levels (Leq) ranged from 70 dBA (ambient noise level when not performing) to 89 dBA (conductor) with maxima around 100 dBA. The sound levels were lower during the rehearsal performances, and more interruptions of the music resulted in greater time between the louder musical segments.

Position	Leq (dBA)	Maximum level (dBA)	% of time above 85 dBA
Woodwinds	82	100	10
Strings near monitors	85	97	30
Between violins and cellos	82	96	15
Strings near woodwinds	85	98	37
Ambient	70	83	0.1
Conductor	89	100	53
Brass	85	99	25
Strings below woodwinds	75	85	9

DISCUSSION

These measures indicate that the performers are exposed to significant sound levels during the performances, that could, if exposure length at these levels was sufficient, cause permanent noise-induced hearing loss in some musicians.

These levels are higher than would be expected for the average levels experienced by these musicians because only amplified concerts, representing only a portion of the performance schedule for the orchestra, were surveyed. In order to determine an individual musician's risk for hearing loss caused by sound exposure, the total daily sound exposures would need to be ascertained.

REFERENCES

[1] Westmore, G.A. and Evans, E. F. (1990). Noise-induced hearing loss in orchestral musicians. Archives of Otolaryngology, 107, 761-764.

[2] Fisk, T. (1996). Frequency resolution in noise-exposed musicians. Master's thesis, University of Western Ontario.

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