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Factors Affecting the Use of Hearing Protectors among Classical Music Players

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Classical musicians are often exposed to sound levels that exceed the Finnish national action limit value of 85 dB(A). Still, the use of hearing protectors is uncommon among musicians. The purpose of this study was to find out musician's attitudes towards hearing protectors, and under which conditions hearing protectors are used. The study group consisted of five major classical orchestras in the Helsinki region. The players were asked to fill out a questionnaire with questions on hearing protection, ear symptoms, including tinnitus, hearing loss, pain in the ears, and temporary ringing in the ears. Also, questions concerning stress and working environments were asked. Of those who responded, 94% were concerned about their hearing to some degree. Only 6% of the musicians always used hearing protector devices (HPDs). Self-reported hearing loss was quite common, with 31% of the musicians reporting some hearing loss. Temporary tinnitus was even more common at 37%. There were 15% of women, and 18% of men reporting permanent tinnitus. Hyper-acousis was reported by 43% of the musicians. The ear symptoms affected the usage rate. Hearing protectors were used more often among musicians having ear symptoms (20%) than those reporting no symptoms (6%). Further, the 43% of the musicians found their work to be interesting and meaningful. Stress was experienced to some extent by 60%, and musicians with ear symptoms had three to nine times more stress and felt their working environment noisier. The study shows that musicians seldom use hearing protectors before symptoms begin. Symptoms increased usage rate, but the usage levels are still far from ideal. Motivation and training is needed to improve hearing protector use among musicians.

Keywords: musicians, hearing impairment, hearing protectors, usage rate

Introduction

Classical musicians are often exposed to sound levels exceeding national action levels (Royster et al., 1991; Camp and Horstman, 1992; Sabesky and Kroczyński, 1995). In most cases the exposure is evaluated only for performances and group rehearsals, though musicians also rehearse a great deal by themselves. A recent study has shown that rehearsals expose musicians to the same order of magnitude as performances (Laitinen et al., 2003), and therefore should be included in total sound exposure evaluation.

Less attention has been paid to "minor" hearing symptoms: tinnitus, hyper-acousis, ringing in the ears right after rehearsals, etc. These symptoms can influence a musician's ability to work to full capacity and should therefore be acknowledged

as an important part of a musician's health care. Tinnitus is common among musicians, with 59% of musicians in a study by Perälä (1998) found to have suffered from temporary tinnitus. The corresponding figure in a study made among Sibelius Academy students (orchestra instruments) was 70% (Häkkinen, 1997).

Hearing protection for musicians is a complicated issue. The musicians need to hear the music. Most rock musicians use hearing protection at least when rehearsing. However the use of hearing protectors is not so common among classical musicians (Sataloff and Sataloff, 1993). The noise exposure, hearing protection, and attitudes of professional musicians have been studied widely in the Finnish National

Opera (Perälä, 1998, Laitinen et al., 1999). Sound levels measurements showed that almost every instrumental group was exposed to levels exceeding 85 dB (A). Attitudes toward hearing protectors were investigated by a survey, which found that the number of those using hearing protection was small. It was also discovered that at least part of the problem in hearing protector usage could be solved by further education. Hearing protector usage has been surveyed among music students (Häkkinen, 1997), and although knowledge of hearing protection is better with young musicians, who take the subject more seriously, education, and further information is needed.

The purpose of this study was to find out musician's attitudes towards hearing protection, under which conditions hearing protectors are used, and to find out which factors motivate the use of hearing protective device (HPDs).

Materials and methods

The study group consisted of five major orchestras from the Helsinki metropolitan area. A questionnaire was sent to all members of the orchestras. Orchestras, their size and return rates of the questionnaires are shown in Table 1. The Guards Band (GB) is a military brass band, and all the other orchestras are symphonic orchestras. Before answering the questionnaire, orchestra members were informed about the purpose of the study. All answers were anonymous.

The questionnaire consisted of 35 questions. Six questions were open answer, and the rest were multiple-choice questions. Age, gender, instrument group, and playing experience were asked, then questions about job satisfaction, ear symptoms, and stress. Stress was defined as: *a situation when a person feels him/herself tense, restless, or anxious or when he/she has difficulties sleeping due to things bothering him/her*. Hearing problems and annoyance were asked using questions like: *Have you had temporary ringing in your ears after performances or rehearsals?*, *Has loud music caused pain in your ears at work?*, and *Do you find the rehearsals or performances noisy?*. Questions regarding usage of hearing protectors were separated into usage during individual rehearsals, orchestra rehearsals, and performances. Also queried was the type of hearing protectors tried and used. The open questions regarded problems concerning usage of HPDs, and playing facilities.

The total per cent of musicians who responded was 51%. There were 134 answers from men, and 62 answers from women. The questionnaire data was analysed using SPSS 8.0. The study is descriptive and results are presented in per cent and as odd ratios.

Results

As string players are in the majority in symphony orchestras, they also returned the largest amount (55%) of answers. Others groups were flutes (3%), woodwind instruments (17%), brass instruments (18%), percussion (5%), and

Table 1. Participating orchestras, their size and return rate of questionnaires.

Orchestra	Number of members	Number of answered	Answer Percentage (%)
Finnish National Opera (FNO)	112	69	62
Finnish Radio Symphony Orchestra (RSO)	98	38	39
Helsinki Philharmonic (HP)	93	48	52
Tapiola Sinfonietta (TS)	40	19	48
The Guards Band (GB)	40	22	55

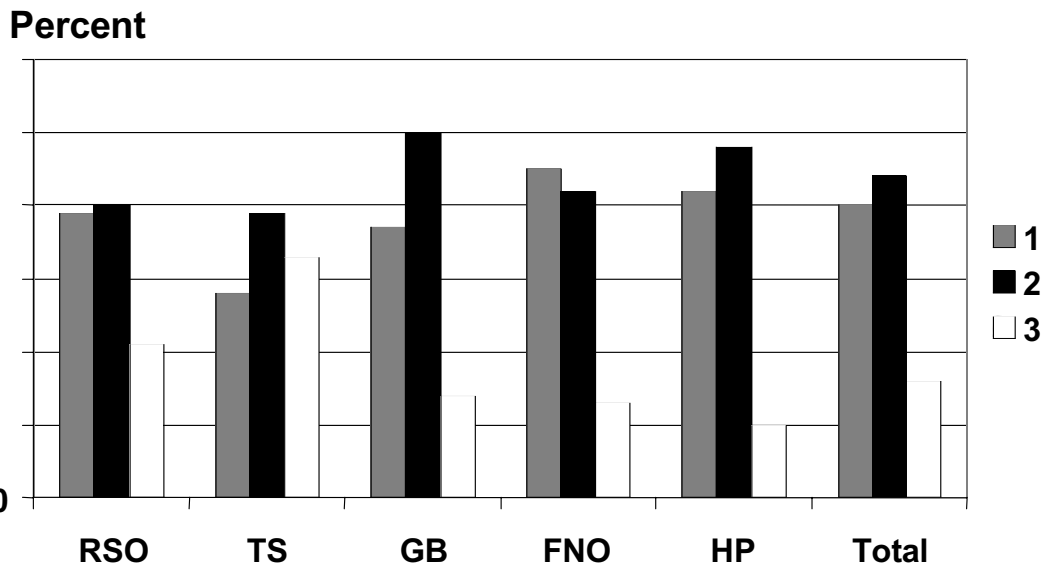


Figure 1. Self evaluated stress in different orchestras. (Stress 1= not at all or only a little, 2= to some extent, 3= quite a lot or very much)

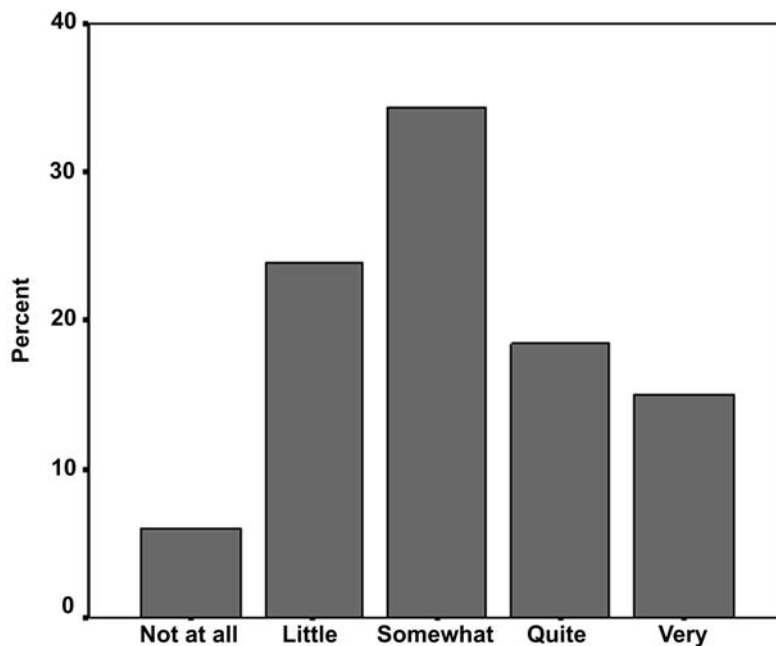


Figure 2. Distribution of musicians' worry about hearing. (Question was Are you worried about your hearing?, and the choices were not at all worried, only a little worried, somewhat worried, quite worried, very worried).

others (2%). Almost one half (43%) had been playing in a professional orchestra for over 20 years.

Stress and health related questions

The job satisfaction of the musician was found to be high. The claim: “work is inspiring and meaningful” was *completely agreed* with by

43%, and *almost agreed* with by 35%. Devotion to work was *completely agreed* with by 31%, and *quite agreed* with by 39%. Still, the work was considered to be *strenuous to some extent* by 50%, *quite strenuous* by 36%, and *very strenuous* by 4%.

Table 2. Hearing symptoms reported, sorted according to orchestra. (Ringing 1 is temporary ringing in the ears after rehearsals, or performances, and Ringing 2 is temporary ringing in the ears after individual rehearsals. The cases included to Ringing 1, Ringing 2 and Pain are musicians who are suffering from these symptoms sometimes, quite often or always. Superscripts indicate the number of missing answers).

	HL (yes) n (%)	HL (no) n (%)	Tinnitus n (%)	Ringing 1 n (%)	Ringing 2 n (%)	Pain n (%)
GB (n=22)	6 (27)	13 (59)	6 (27)	13 (59)	9 (41)	10 (45)
Gender separation was not made due to protection of privacy						
TS (n=19)	11 (58)	8 (42)	1 (5)	3 (16)	3 (16)	8 (42)
Women (n=11)	6 (55)	4 (36)	0 (0)	1 (9)	1 (9)	3 (30)
Men (n=8)	5 (63)	2 (25)	1 (13)	2 (25)	2 (25)	5 (63)
FNO (n=69)	24 (35)	37 (54)	14 (20)	18 (26)	10 (14)	27 (39)
Women (n=28)	9 (32)	16 (57)	8 (29)	9 (32)	6 (21)	14 (50)
Men (n=41)	15 (37)	21 (53) ¹	6 (15)	9 (22) ¹	4 (10) ¹	13 (32)
HP (n=48)	10 (21)	31 (65)	6 (9)	9 (13)	5 (7)	19 (28)
Women (n=12)	2 (17)	9 (75)	1 (9) ¹	4 (33)	1 (9) ¹	4 (33)
Men (n=36)	8 (22)	22 (61)	5 (14)	5 (14) ¹	4 (11)	15 (42)
RSO (n=38)	9 (24)	23 (61)	6 (16)	16 (42)	8 (21)	20 (53)
Women (n=10)	5 (50)	5 (50)	0 (0)	4 (40)	1 (10)	6 (60)
Men (n=28)	4 (14)	18 (64)	6 (21)	12 (44) ¹	7 (27) ²	14 (50)
Total (n=196)	60 (31)	112 (57)	33 (17)	59 (30)	35 (18)	84 (43)

Of all respondents, 47% felt that they *sometimes* did not have enough time to complete all of their work properly. One of the orchestras, Tapiola Sinfonietta (TS), was more stressed than the others (Figure 1). The stress was also related to health in general. In the same orchestra, those musicians who had more stress also felt that their health was worse than those who had less stress.

Musicians were worried about their hearing: 34% were *quite worried* or *very worried* and 35% were *worried to some extent* about their hearing (Figure 2). There were no statistically significant differences between orchestras ($p=0.38$).

Rehearsals and performances were found *quite noisy* by 32%, and *extremely noisy* by 26% of subjects. Between orchestras, there was a big difference between TS and GB. In TS, performances and rehearsals were found *quite noisy* or *extremely noisy* by 21%, and in GB the corresponding figure was 91%. However, individual rehearsals were not found so noisy: 13% thought they were *quite noisy* and 2%

extremely noisy. Again results from GB differed, 27% found their individual rehearsals *quite noisy*.

Temporary ringing in the ears was experienced *sometimes* by 17%, *quite often* by 8%, and *always* by 6% after orchestra rehearsals. The corresponding figures after individual rehearsals were 10%, 5%, and 3%. In GB, temporary ringing in the ears was experienced a bit more in orchestral rehearsals. It was reported that 15% of women, and 18% of men had permanent tinnitus. Permanent tinnitus was most frequent in GB (27%) and less frequent in TS (5%). Self-reported worsened hearing (HL) is shown in Table 2. TS had more cases of hearing symptoms than the other orchestras.

Musicians experienced hyper-acousis *sometimes* in 27% of cases, *quite often* in 13% of cases, and *always* in 3% of cases. There were no significant differences between the orchestras. The pain was described as ‘smart, sharp pain’ (N=36), ‘ripping, grating, jarring pain’ (N=19), ‘sense of

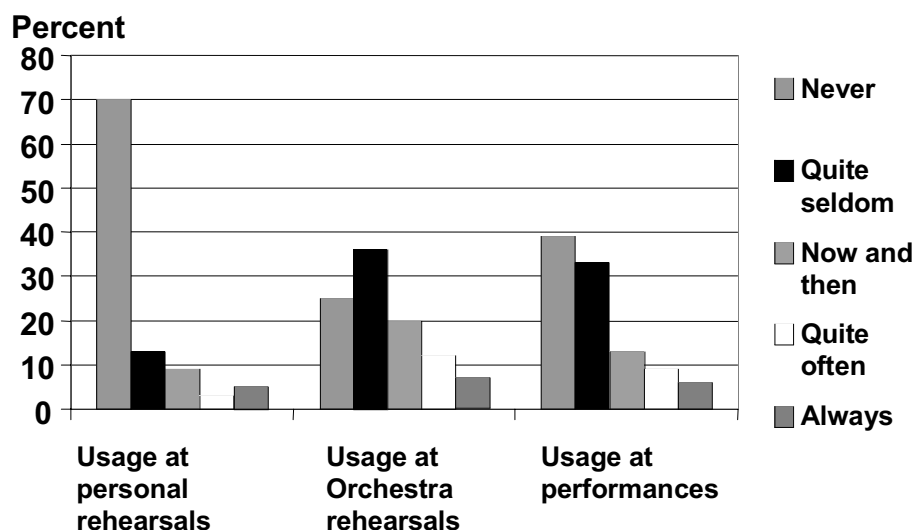


Figure 3. Hearing protector usage in work.

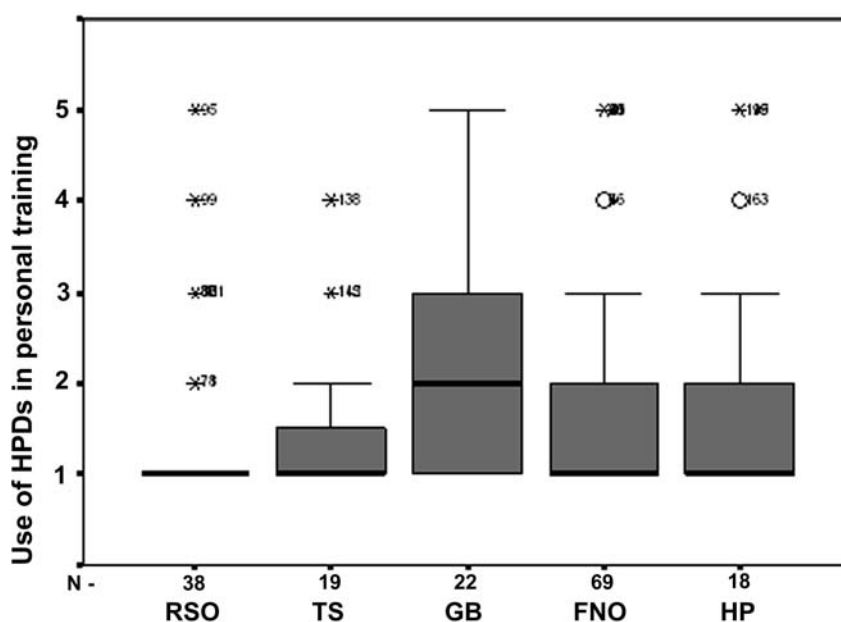


Figure 4. The usage of hearing protectors at individual rehearsals by orchestra. (1=never, 2= seldom, 3=sometimes, 4=often, 5=always; numbers mark the outliers)

pressure' (N=8), 'distortion of sounds' (N=8), 'humming in the head' (N=4), 'stuffed ears' (N=3), 'nausea' (N=2), and 'warming feeling in the ear' (N=2). Single comments included descriptions like: crackle, feeling of panic, jamming feeling, feeling of weakness, torture, booming inside the head, and sense of ear infection.

Usage of hearing protectors

HPDs were mainly used in orchestra rehearsals and performances (Figure 3). There were no significant statistical differences between orchestras except individual rehearsals. In individual rehearsals, very few used HPDs. In Finnish Radio Symphony Orchestra (RSO), only some musicians used HPDs, and HPDs were used to some degree in GB (Figure 4). The difference between RSO and GB was

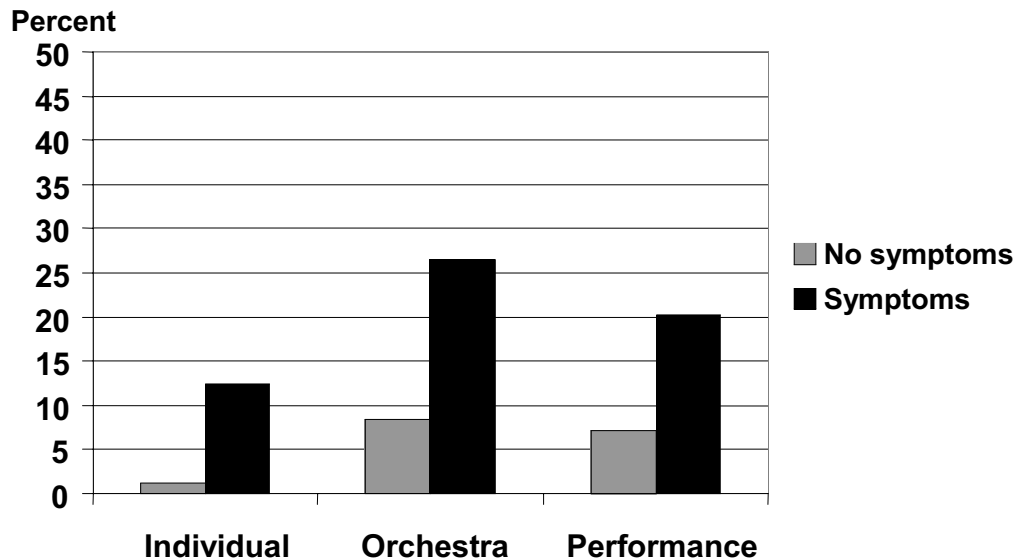


Figure 5. Effect of hearing symptoms to the use of hearing protectors at individual rehearsals, orchestra rehearsals, and performances.

statistically significant ($t=0.012$). The difference between GB and the other orchestras was also statistically significant ($t=0.033$).

Usage rate of HPDs was clearly affected by the hearing symptoms (Figure 5). In individual rehearsals, HPDs were used *often* or *always* by 2% of musicians without hearing symptoms, and by 12% of musicians with hearing symptoms. The same tendency was shown in orchestra rehearsals (9% versus 22%) and performances (7% versus 20%).

The usage of different types of hearing protectors was also studied. The most popular type used was custom-moulded earplugs (47%), followed by disposable earplugs (25%). There were other choices like regular cotton, tissues and hands, accounting for 12%. One particularly popular choice was to use two types of HPDs side by side: disposable earplugs and custom-moulded earplugs were used by 10% of the musicians (these numbers are not included to percentages of the musicians wearing only custom-moulded or disposable earplugs). Noise cotton, and hifi-plugs were each used by 3%. There were no statistical differences between genders, but orchestras differed in the sense that custom-moulded earplugs were not used in TS, but custom-moulded earplugs were used by the

majority of musicians using HPDs in GB. Also, the situations where different types of HPDs were used did not differ: each type was used the same amount regardless of whether they were used in individual rehearsals, orchestra rehearsals, or performances. From different instrument groups, brass players used almost exclusively custom-moulded earplugs.

Musicians were also asked about problems in hearing protector usage. The most common reason for usage was that musicians were afraid of hearing loss and tinnitus. Other often mentioned reasons were to avoid pain, to protect their ears from fatigue, to decrease stress, irritation, and fatigue, and due to already existing hearing loss and tinnitus. However, it seems that the problems created by wearing HPDs are worse than the fears of hearing loss. Hindrance and other problems with usage were listed as follows:

- * Hinders own performance (N=155)
- * Difficult to hear others play (N=88)
- * Sensation from hearing protectors is unpleasant (N=15)
- * Difficult to insert (N=12)
- * Communication problems in rehearsals (N=4)
- * Existing hearing loss makes usage difficult (N=3)

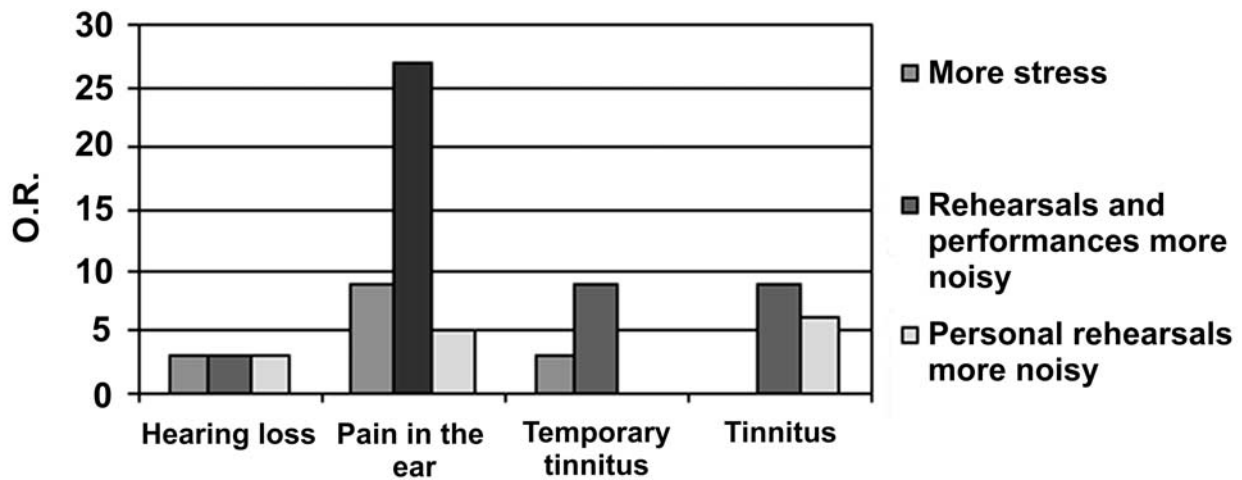


Figure 6. Effect of hearing symptoms to job satisfaction and stress (odds ratios).

Hearing symptoms related to other factors

Hearing symptoms were compared to stress and working environment with odds ratios (Fig 6). Hearing symptoms had a clear impact on job satisfaction and stress. There were three times more who experienced stress than among those who had hearing loss, and nine times more among those who had pain in the ear.

Discussion

Sound level measurements have shown that the national action level is exceeded in all orchestras. Musicians have a high prevalence of ear symptoms. In a normal population 15% have tinnitus, whereas 37% of the musicians surveyed have tinnitus. Permanent tinnitus seems to be associated with the perception of noise. Musicians in The Guards' Band had the most cases of permanent tinnitus, while musicians in the Tapiola Sinfonietta had less than musicians in other orchestras. Similar tendencies were also discovered in noisiness evaluations. Members of GB had more temporary ringing in their ears than members of other orchestras. Because GB consists almost entirely of brass instruments, almost every musician is exposed to high sound levels, and corresponding symptoms were more frequent. TS however is a smaller symphony orchestra, and in which the sound levels are lower.

Musicians are satisfied with their work. However, they are stressed, and one of the reasons for the stress can be pre-existing hearing problems. It is important to remember that also other factors can contribute to the stress, and lower musician's ability to play without additional efforts. There are other hearing symptoms to be considered, for example tinnitus and hyper-acousis. In this study a connection between some of these hearing symptoms and stress was found. It is difficult however to say whether the stress increases the incidence of these symptoms or the existing symptoms increase the stress felt. In the worst case, it can be both and the processes fortify each other.

Also, it seems that those musicians suffering from hearing symptoms more frequently use HPDs than those without symptoms. Musicians were worried about their hearing, yet they seemed to be reluctant to use HPDs, which are often the only solution to protect hearing. It would seem that the musicians with problems start to use HPDs only after the problems appear. This is supported by the comments from musicians themselves when asked about the reasons to use HPDs. Some of them admitted that they use HPDs because of already existing hearing loss and tinnitus, and also to protect the ears from pain. Because of the fact that only very few musicians have used HPDs as music

students, the assumption is that hearing symptoms are the major reason for the use of HPDs.

Hearing protectors are not used in individual rehearsals though measurements (Laitinen et al., 2003) have showed that it is essential to use them both during orchestra rehearsals and individual rehearsals. In GB, HPDs are used more often at individual rehearsals than in all other orchestras. This is probably due to the large number of loud instruments in the orchestra. The number of musicians using hearing protectors is larger than what Kähäri et al. (2002) found (10%), but a direct comparison is difficult to make, since scaling has been used and also individual rehearsals were separated as their own group. The results support the comments that musicians feel their own instrument is not noisy, but it is the neighbouring instruments that cause the problems.

The best results are achieved when HPDs are worn by motivated users. Low motivation to wear HPDs is seen in low usage rates and low attenuation values (Foreshaw and Cruchley, 1982). Increasing motivation can be obtained via appropriate education and training. The users must be informed about the effects of noise and the risks at work (89/188/EEC). For industrial workers, best results are obtained if personal audiometric data is used (Lipscomb, 1994). For musicians, other hearing symptoms are important and must be taken into consideration when promoting their use. At present, HPDs are used only as a last resort. For a musician, hearing is of major importance. Any obstacles to hearing can deteriorate the quality of playing. HPDs deteriorate intelligibility, and if hearing is already deteriorated by hearing loss, the use of HPDs may become impossible.

Although special HPDs with flat attenuation are designed for musicians, it is not simple to start using them. The fact that musicians with hearing symptoms use HPDs more often indicates that it is possible to get used to them. However it can take two to three months to get used to them, and this can vary between individuals.

When HPDs are used, musicians mostly use the custom-moulded earplugs with flat attenuation. However, if the HPDs are not paid for by the employer, musicians can make the decision not to buy them because they consider them to be too expensive. Brass players seem to favour custom-moulded earplugs. This is probably due to the valve in the earplug that lowers the pressure in the ear canal of which brass players sometimes complain. Disposable earplugs are also popular among musicians. Some musicians commented that custom-moulded earplugs are difficult and slow to use, so they instead use disposable earplugs when they need protection quickly. Because it takes time to properly insert a disposable earplug, the earplug may then only be partly inserted into the ear, reducing the attenuation of the earplug.

The orchestras in this study are representative of typical symphony orchestras except for GB. GB in turn is a typical example of a military brass band. Also the answer rate was over 50 %, which can be considered sufficient. Though musicians answered the questionnaire voluntarily, they were asked to answer whether they had problems or not. Thus these results should be applicable to other orchestras of the same type.

Some of the problems in the usage of HPDs can be solved. For example, paying special attention to hygiene can prevent ear infections. For many musicians, the first problems are a reason to quit using the hearing protectors. If it were understood that there are always problems, but that they can be dealt with, usage rates could likely be increased.

Conclusions

Musicians are sensitive to many hearing symptoms, and seem to start to use HPDs when the symptoms appear. They are worried about their hearing, but the usage of HPDs is small and especially neglected in individual rehearsals. To increase usage rates, good education, giving information about typical problems and how to deal with them is needed. The training period can be quite long before the musician feels fully comfortable with HPDs.

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