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USE AND EFFECTIVENESS OF HEARING PROTECTORS

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ABSTRACT

Data from regular audiometric investigations made during the last 25 years at noise exposed workers are used to determine the rate of the use of hearing protectors considering age, sex and sound pressure level. To evaluate the effectiveness of hearing protectors we analyzed the hearing threshold differences of permanent users and non users as a function of exposure time and sound pressure level. The overall hearing protector wearing rate in the period from 1996 to 1998 is 73,8% which relatively high. A protective effect of hearing protectors can be seen at least for 4kHz.

1 - INTRODUCTION

Workers who are exposed to 8h equivalent levels over 85 dBA have to wear adequate hearing protectors. This is mandatory according to the Austrian Health and Safety Act [1]. The questions now are:

- Do the overexposed workers follow this obligation?
- Under what conditions do they use their hearing protectors?
- How effectively are hearing protectors worn, that is to say, do hearing protectors really protect the ear?

To get an insight into these problems we used two kinds of data sets which are briefly described now.

2 - GENERAL DATA SET

To get an overview about wearing quality of hearing protection devices (HPD) we used the data gained in the Austrian Workers Compensation Board (AUVA) hearing conservation program of the years 1996 to 1998. These were in total 58.957 data set of different persons (men: 54.630 – 92,7%: women: 4.327 – 7,3%), containing information about age, sex, level, exposure time, HPD, pure tone audiograms of both ears and the results of a medical anamnesis (ear diseases, head injuries, tinnitus, head ache). The measurement procedure and instrumentation are described in detail in [2].

3 - SCREENED DATA SET

To evaluate the effectiveness of HPDs we have to eliminate confounders as good as possible. We therefore restricted available data according to the following rules:

- Age at the first audiometric investigation: < 21a;
- First audiogram: no HTL > 20 dB in the frequency range between 1 and 8 kHz;
- At least 2 audiograms with a 3 years time difference between;
- Permanent HPD usage or no HPD usage since the beginning of work life (clear separation of HPD users and non users);
- Defined 8h equivalent SPL.

4 - USE OF HEARING PROTECTORS

In the observed period the overall HPD wearing rate is 74,3% (40.602) for men and 66,5% (2.877) for women. Women significantly prefer to use plugs (78,7% of all users) and men slightly prefer muffs (57,5%).

The wearing rates of the female workers fluctuate between 60% and 75% for the age groups between 15 and 55 years. Due to the higher number of male workers the dependence of their wearing rate on age is smoother. It has a maximum (Fig. 1) between 21 and 40 years (76% – 79%). Then it decreases steadily to about 70% at 55 years.

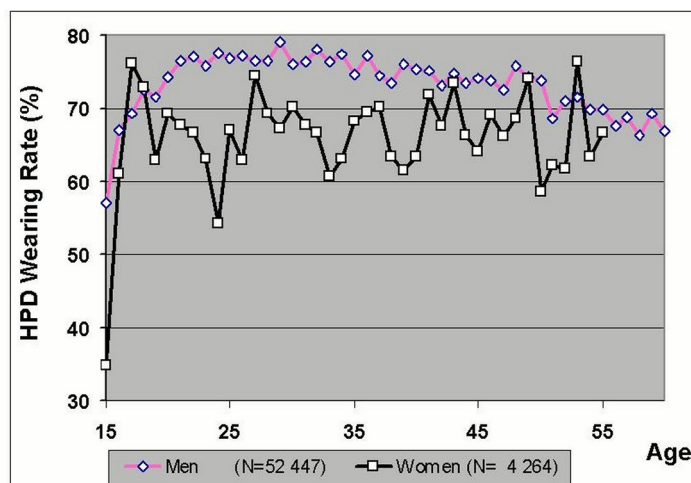


Figure 1: Use of hearing protectors as a function of age and sex.

Whereas the wearing rate is only slightly dependent on age it considerably increases with increasing exposure level (Fig. 2). Workers exposed to high levels obviously try to reduce their risk of getting damaged by an increased application of HPDs.

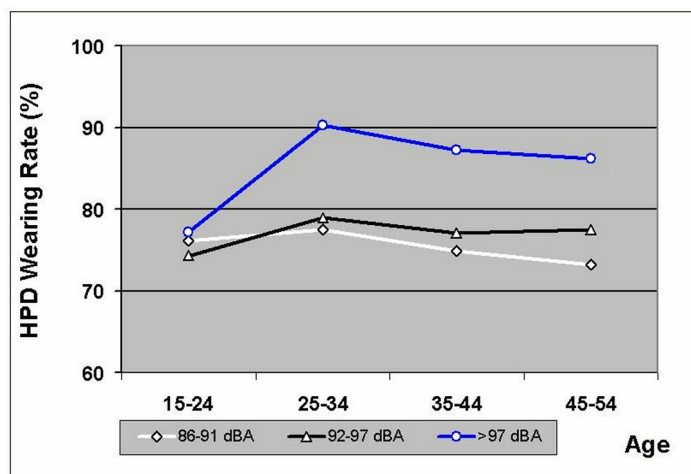


Figure 2: Hearing protector wearing rate as a function of age and exposure level.

It can be generally observed that workers who suffer from tinnitus, subjectively experienced hearing loss, head injury, ear diseases or head ache use HPDs significantly more frequently (Table 1).

Cause	Odds ratio	Conf. Interval (95%)
Tinnitus	1,54	$\pm 0,10$
Subjectively experienced HL	1,43	$\pm 0,06$
Head injury	1,20	$\pm 0,07$
Ear disease	1,17	$\pm 0,12$
Head ache	1,16	$\pm 0,09$

Table 1: Causes that increase the use of HPDs significantly.

5 - EFFECTIVENESS OF HEARING PROTECTORS

The effectiveness of hearing protectors has been evaluated for the 4 kHz hearing threshold of the left ear. 4 kHz was used because according to ISO 1999 [3] the ears are most sensible to noise at this frequency. The left ears were used because their thresholds are generally worse than those of the right ears. A measure for the decrease of hearing sensitivity during the work life is the difference between the first and last audiogram of a worker. The expected theory is that this difference should be smaller for those workers who consequently used HPDs in noise. Figure 3 shows the results for this analysis and it can be seen that the hearing protectors saved hearing at 4 kHz to up to 10 dB.

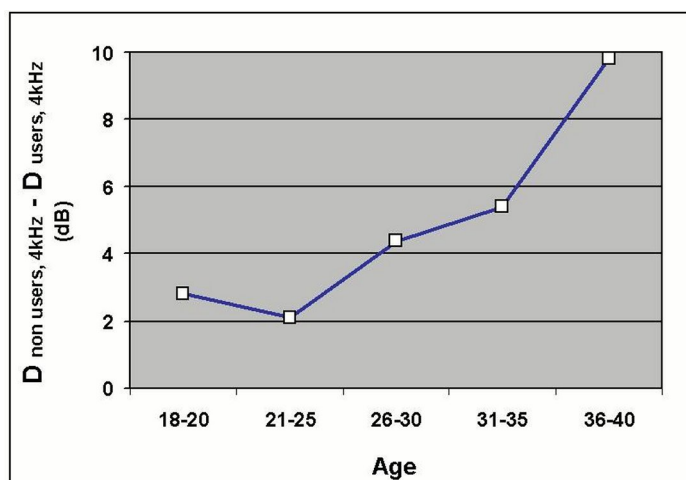


Figure 3: Protection effect of HPDs ($D(4\text{kHz})_{\text{users, 4kHz}} \dots \text{HTL}(4\text{kHz})_{\text{last audiogram}} - \dots \text{HTL}(4\text{kHz})_{\text{first audiogram}}$).

6 - RESUME

The rate of overexposed workers who use HPDs is already high. About 3/4 of male and 2/3 of female workers who mandatorily should use HPDs really do that. This is a quite satisfying result but we nevertheless have the tedious task to motivate the rest to apply HPDs too.

A first analysis for 4 kHz hearing thresholds shows that HPDs seem to be effective. However, further analysis has to be done to investigate the effectiveness for other frequencies and its dependence on variables like noise dose, exposure time and sex.

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