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Non-auditory effects of noise in industry

IV. A field study on industrial noise and blood pressure

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Summary. Audiometry and casual blood pressure measurements were carried out among industrial workers exposed to noise levels exceeding 80 dB(A). Workers with long-term noise exposure had increased blood pressure, after correction for age. Only a weak correlation was observed between noise-induced hearing loss and the corrected blood pressure. The influence of other working conditions and of the relative body weight could not be evaluated.

Key words: Noise in industry – Blood pressure – Hearing loss

Introduction

An occupational health service that carried out periodical audiometry among workers exposed to noise levels exceeding 80 dB(A) was contacted. The authors assessed, in a cross-sectional design, the relationships between the casual blood pressure and both duration of exposure to noise and noise-induced hearing loss.

Material and methods

A total of 428 male workers with exposure to noise levels exceeding 80 dB(A) from production departments of six factories were examined. This included: (1) assessment of the duration of exposure to industrial noise; (2) an otological anamnesis; (3) an otoscopic examination; (4) audiometry; (5) measurement of casual blood pressure. There was a nonresponse of 10%, because of absence due to temporary sickness or holiday leaves.

The level of exposure to noise at the work sites was measured with a Bruel and Kjaer sound level meter type 2209 (area sampling). Exposure levels ranged from 78 to 98 dB(A).

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The blood pressure was measured with a calibrated aneroid sphygmomanometer, brand Manuell, type Primus II in sitting subjects. Audiometry was carried out with a Peekel D77 continuous audiometer (air conduction, pure tones). As measure of hearing loss, the largest loss at 3150, 4000 or 6300 Hz was chosen (according to Jonsson and Hansson 1977; Manninen and Aro 1979; Cohen et al. 1980), after correction for presbyacusis according to Spoor (1972). Workers ($n = 131$) with non-noise-induced ear pathology or with past exposure to explosions were excluded from the analysis.

Data on past exposure to noise, not during their present employment, were assessed by means of a personal work history.

The final analysis could be carried out for 297 workers, divided into two groups: those only exposed to noise during their present employment ($n = 238$) and those also previously exposed ($n = 59$); for the first group it was assumed that the exposure levels in the past were similar to the levels at the time of the investigation.

Results

Table 1 presents the average systolic and diastolic (Korotkoff tone I, respectively V) blood pressure according to duration of exposure to noise for the 238 workers only exposed during their present employment, before and after correction for age. In those exposed up to at least 20 years, the corrected systolic blood pressure was on average about 16 mm and the diastolic blood pressure on average about 7 mm higher than in workers exposed fewer than ten years. The percentage of workers with hypertension (≥ 160 mm systolic, ≥ 95 mm diastolic blood pressure or both) after standardization for age, increased from 9% in those with fewer than ten years' exposure to 28% in those exposed for over twenty years. It is not known how many workers received medication or whether they consumed a salt-limited diet.

Table 2 presents the coefficients of correlations between the duration of exposure and the systolic and diastolic blood pressure in workers without "other" ear pathology and without previous exposure to noise elsewhere, before and after correction for age and for differences between the six industries. Correction for age decreased the coefficient of correlation; the industry of present employment had no influence.

There was also a significant positive relation between the degree of hearing loss and the blood pressure for all 297 workers without "other" ear pathology. This correlation disappeared after correction for age, because age is highly cor-

Table 1. Blood pressure according to duration of exposure to noise levels in workers without "other" ear pathology and without previous exposure to noise elsewhere, before and after correction for age ($n = 238$)

Duration of exposure	0–9 years ($n = 136$) m ± SD	10–19 years ($n = 79$) m ± SD	≥20 years ($n = 23$) m ± SD
Systolic blood pressure	128.5 ± 12.9	130.9 ± 16.4	144.8 ± 22.9
After correction	128.0	131.8	144.5
Diastolic blood pressure	78.7 ± 9.1	80.9 ± 9.7	89.1 ± 12.5
After correction	79.3	80.6	86.7

Table 2. Correlation between duration of exposure and systolic and diastolic blood pressure before and after correction for age and for industry of employment for workers without "other" ear pathology and without exposure elsewhere ($n = 238$)

	Systolic blood pressure	Diastolic blood pressure
Duration of exposure (years)	0.32	0.35
Duration of exposure (years) after correction for age and industry	0.29	0.21

All $P < 0.05$ two-sided

related both with the blood pressure and the degree of hearing loss. Only for hearing loss in the left ear did a weak correlation persist with systolic blood pressure ($r = 0.11$, $P < 0.05$, one-sided).

Discussion

Selection through disease or death will probably not explain the results. When no selection had occurred, the correlation between blood pressure and duration of exposure would be even stronger.

The possibility could not be excluded that in one of the six industries an unknown complex of factors might have confounded the relation; however, correction for the present industry of employment did not affect the observed relation. No data on lenght and body weight were available; the relative weight might have been a confounder. However, this confounder probably will at most have played a minor role because of the age correction.

It is also possible that other adverse working conditions might have contributed to the increased blood pressure, keeping in mind the agent-non-specificity of increased blood pressure and possible interaction effects of combined exposure. This aspect will particularly be studied in the field studies reported in the following papers V and VI.

The use of hearing loss as a measure for exposure to noise can be disputed. In individual subjects it is certainly not an adequate measure of exposure. Nevertheless, a correlation between hearing loss and blood pressure, as found in this and in the next study (V), may be valuable in explaining why some subjects are more sensitive to noise-induced hearing loss than others. A positive correlation was also presented by Johnsson and Hannson (1977) and more recently by Talbott et al. (1985). Supporting evidence comes from an animal study by Borg and Møller (1978). Negative observations have been made in other field studies (Drettner et al. 1975; Hedstrand et al. 1977; Takala 1977; Manninen and Aro 1979; Cohen et al. 1980).

Conclusions

This study provides suggestive evidence that long-term exposure of workers to noise levels exceeding 80 dB(A) may lead to increased blood pressure. How-

ever, this evidence should be regarded with caution, because of possible influences of other working conditions and of the relative body weight.

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