SHORT REPORT

Hearing losses in wholetime firefighters occurring early in their careers

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Introduction

North American research suggested that firefighters lose hearing acuity faster than expected during their careers compared with age-matched populations [1–3], although Bohle and Clarke disagree [4]. Since the hearing loss was generally high frequency, noise was thought to be responsible, but studies showed that, although firefighters were exposed to impact noise, when noise levels were averaged out over working shifts, recommended limits were rarely exceeded [1]. Personal observation of audiometry carried out on firefighters applying for a large goods vehicle (LGV) licence a few years after recruitment suggested that greater than expected hearing loss was occurring. The aim of this study was to investigate if this worsening of auditory acuity was occurring early in firefighting careers.

Methods

In order to test the hypothesis (that there is a significant hearing loss occurring between the enlistment and initial LGV medical examination), after calculating ages at enlistment and LGV licence medical to the nearest year, any data (e.g. names, dates of birth, enlistment, LGV medical etc.) that might allow identification of specific individuals was cleared from the Excel 2003 spreadsheet. An Amplivox 116 screening audiometer (Amplivox, Kidlington, UK) was used to measure auditory thresholds from 0.25 to 8.0 kHz in each ear. The hearing losses at 1, 2, 3, 4 and 6 kHz were added together, as per the Control of Noise at Work Regulations (CNAW) 2005 [5,6].

The audiometric data were additionally analysed using the standards applied by the British Armed Services. This technique adds separately the hearing losses in each ear at low frequencies (0.5, 1 and 2 kHz) and high frequencies (3, 4 and 6 kHz) [7]. This enabled the effects on high and low frequencies to be explored. A grade is allocated to each ear, with H1 = good hearing, H2 = adequate hearing and H3 or more = impaired hearing.

At the LGV medical, each subject was asked ‘Do you have any problems with your hearing, or not?’ Descriptive and hypothesis testing statistics were calculated using Minitab v 15 (Mintab Ltd, Coventry, UK).

Background

Most research on firefighter hearing loss has concentrated on effects over a substantial part of, or entire, firefighting career.

Aims

To examine short-term changes in hearing in a group of local authority firefighters during their early careers.

Results

Altogether, 118 firefighters, all male, were examined for an LGV licence over a 2.5-year period to September 2005. Data were available for 89/99 right/left ears on enlistment and 99/100 for LGV. Mean time between examinations was 4.1 years (range 1.4–12.6 years). By the LGV examination, there was deterioration in 69/99 right and 77/100 left ears, with the hearing loss in 8% of right and 13% of left ears falling into the ‘warning’ or ‘referral’ categories (Control of Noise at Work Regulations 2005) compared with 1% at enlistment. These differences reached statistical significance (P < 0.05 and < 0.001, respectively).

Conclusions

Statistically significant hearing losses occur in some firefighters during the early stages of their careers. Further work needs to be done to establish if this continues, and steps taken to reduce the noise hazard at work.
Results
The study covered a 30-month period ending in September 2005 during which 118 consecutive firefighters, all male, attended for their first LGV examination. Time between enlistment and LGV medicals ranged between 1.4 and 12.6 years, mean 4.1 (SD 1.8). Thirty examinations were conducted during the third year of service (mode). Table 1 summarizes demographic and hearing loss characteristics of the participants at each examination.

When the hearing losses at the initial LGV medical were compared with those at enlistment, in the right ear, 69/99 (70%) showed deterioration and 10/99 (10%) no difference (i.e. within 5 dB of enlistment). For the left ear, the proportions were 77/100 (77%) and 13/100 (13%), respectively. Mean hearing loss was worse in the left ear in both examinations—20.7 versus 24.7 dB (SD both 23.4) at enlistment and 44.6 (SD 24.0) versus 54.1 (SD 34.7) at LGV. The difference at LGV reached statistical significance ($P < 0.05$, 95% CI 17.8–1.1). None of the subjects declared any hearing difficulties.

When the military criteria were applied, statistically significant differences occurred between low- and high-frequency losses in each ear at the LGV examination. In most cases, a change from a hearing acuity of H1 to H2 is not considered to be of much consequence. Therefore, the numbers with H1 and H2 hearing in each ear at each examination were added together, comparing them with the numbers whose hearing acuity was H3 or more. None of the differences between proportions reached significance.

Table 2 shows that there was a statistically significant increase in the proportions of firefighters whose hearing loss was regarded as the subject of warning or referral advice under the terms of the CNAW Regulations when hearing losses at the LGV medical were compared to enlistment. Bilateral hearing loss occurred in 6 of the 21 ears, which reached this level of hearing loss at the LGV medical.

Mean age of the 18 candidates excluded from the LGV analysis because of incomplete data (6—no enlistment date, 12—missing audiometric data and 2—others) was 31.9 years. When compared with the participants, the difference did not reach statistical significance.

Discussion
These firefighters showed a striking reduction in hearing acuity over a short period, early in their careers. However, there was no contemporaneous assessment of noise exposure. Furthermore, before these findings could be generalized to the wider fire and rescue service, it would be inappropriate to examine the hearing of groups of firefighters who did not seek to become LGV drivers or already held this licence at enlistment, at similar points in their service. Both examinations were performed to fulfill statutory requirements—The Fire Services (Appointments and Promotion) (Scotland) Regulations 1989 and 2nd EC Directive on driving Licences (91/439/EEC). A noise survey carried out by a Scottish Fire Brigade in 1993–94 was generally reassuring, but noise exposures of ≥85 dBA, often ≥90 dBA (8 h time-weighted average), were measured during travel to incidents, pump operation, turntable ladders and hydraulic platforms [8]. Firefighting techniques evolve, and increasing deployment of firefighters to Urban Search and Rescue (USAR) operations requires training with, and work involving use of, powered tools. A survey reported in 2008 that the hazards detected by the earlier survey were still extant if not worse but this was partially due to the replacement of the Noise at Work Regulations 1989 [9] by the rather more stringent CNAW. However, powered devices like Positive Pressure Ventilation Fans and an air wrench produced noise levels of 103 dBA, and a Zip gun 109 dBA, reaching the upper action levels in 7.5 min and 90 sec, respectively [10].

USAR operations are unlikely to occur frequently, but firefighters may spend considerable time training for them, particularly in the earlier stages of their careers. Instructors, a group not included in this survey, may also be at risk since they may be required to repeatedly demonstrate techniques to students.

Table 1. Demographic characteristics of firefighters ($n = 118$) and hearing losses at enlistment and LGV medicals

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Enlistment</th>
<th>LGV</th>
</tr>
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<tbody>
<tr>
<td>Age (years)</td>
<td>Mean (±SD)</td>
<td>25.3 (3.9)</td>
</tr>
<tr>
<td></td>
<td>Median (IQR)</td>
<td>26.0 (22.0–28.0)</td>
</tr>
<tr>
<td></td>
<td>Range</td>
<td>18.0–33.0</td>
</tr>
<tr>
<td>Hearing loss (dB)</td>
<td>Mean (±SD)</td>
<td>45–115*</td>
</tr>
<tr>
<td>Right ear</td>
<td>Mean (±SD)</td>
<td>20.0 (7.5–35.0)</td>
</tr>
<tr>
<td></td>
<td>Median (IQR)</td>
<td>20.0 (10.0–40.0)</td>
</tr>
<tr>
<td></td>
<td>Range</td>
<td>−25 to 125†</td>
</tr>
<tr>
<td>Left ear</td>
<td>Mean (±SD)</td>
<td>50 (40.0–63.8)</td>
</tr>
<tr>
<td></td>
<td>Median (IQR)</td>
<td>54.1 (34.7)</td>
</tr>
<tr>
<td></td>
<td>Range</td>
<td>10–145</td>
</tr>
</tbody>
</table>

* $P < 0.001$, 95% CI −30.7 to −17.1, DF 184 (two sample t-test); $P < 0.001$, 95% CI −29.9 to −14.9 (U-test).

† $P < 0.001$, 95% CI −37.8 to −21.0, DF 174 (two sample t-test); $P < 0.001$, 95% CI −35.0 to −21.0 (U-test).
Further research should aim to confirm or refute these findings in similar groups of firefighters, conducting longitudinal studies extending throughout careers and including those who do not become drivers. These studies should also include contemporaneous assessments of workplace noise exposure, particularly when novel tools are brought into service or new fire fighting roles evolve.

Acknowledgement

The author would like to thank Mrs A. M. M. Ide for her helpful comments.

Table 2. Proportions of firefighters with hearing in at least one ear, which fell into the ‘Warning’ or ‘Referral’ categories, according to CNAW 2005 at enlistment or LGV medical examinations

<table>
<thead>
<tr>
<th>Right ear</th>
<th>Left ear</th>
</tr>
</thead>
<tbody>
<tr>
<td>Enlistment</td>
<td>LGV</td>
</tr>
<tr>
<td>1/89*</td>
<td>8/99</td>
</tr>
</tbody>
</table>

*P ≤ 0.05 (Fisher’s exact test = 0.017) 95% CI −0.13 to −0.01). Difference between two proportions.

***P < 0.001 (Fisher’s exact test = 0.002) 95% CI −0.19 to −0.05).

Key points

- This group of firefighters showed greater than expected hearing loss on audiometry early in their careers.
- The left ear was more affected than the right.
- This did not appear to affect the quality of life of the firefighters at that point.

Conflicts of interest

None declared.

References