

## Comparison of Sensory–Neural Hearing between Firefighters and Office Workers

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### ABSTRACT

**Background:** Rescuer systems personnel such as firefighters have importance in health assessment. Because of stressful situation, chemicals, metals, gases and noises, they need many physical and paraclinic examination such as audiometry in periodic examinations. Comparison of sensory – neural hearing between firefighters and office workers.

**Methods:** A cross-sectional study had been done on firefighters and office workers with use of the clinical – health issues. Data had been analyzed in SPSS 11.5 by T-test and Chi-2 with significance level of  $P < 0.05$ .

**Results:** Mean of hearing threshold in firefighters' right ear in 4000, 6000, 8000 Hz was  $16.05 \pm 8.66$  dB and in office workers was  $15.20 \pm 6.47$  dB with  $t = 0.786$  and  $P = 0.433$  had no significant difference, this mean in firefighters' left ear was  $16.17 \pm 8.12$  dB and in office workers was  $15.52 \pm 6.67$  dB with  $t = 0.617$  and  $P = 0.538$  had no significant difference too. Mean of hearing threshold in firefighters' right ear in age 40 or less than it in 4000 Hz was  $20.51 \pm 10.11$  dB and in office workers was  $17.50 \pm 5.28$  dB with  $t = 2.153$  and  $P = 0.033$  had significant difference.

**Conclusion:** Mean of hearing threshold in firefighters in all frequencies was normal, except 4000 frequency. It showed the early effect of occupational exposure on hearing.

**Keywords:** Chemical pollution, firefighter, sensory–neural hearing, siren

### INTRODUCTION

Studying about health situation of health rescuer systems specially firefighters have the most importance.<sup>[1,2]</sup> This group because of stressful work situation, exposure to chemicals, solvents such as Toluene, styrene, carbon disulfide, heavy metals such as lead, methyl mercury, Arsenic, gases such as carbon monoxide, noise, Alarm, need to pre-placement and periodic clinical examinations and paraclinic tests such as audiometry. For this importance, this study had been performed.<sup>[3]</sup>

In recent years, health systems in the world have more attention to firefighters' organ systems health, except auditory but injuries especially to auditory system maybe cause of impairment and sometimes disability in firefighters.<sup>[4]</sup>

Usually neurosensory hearing loss are shown when personnel have exposure to 85-90 dB or exposed to some solvents such as toluene, styrene, carbon disulfide, heavy metals such as lead, methyl mercury, arsenic, gases such as carbon monoxide and some drugs for example aminoglycosides, cisplatin and noise simultaneously.<sup>[5,6]</sup>

However, mean of noise that firefighters exposed to in one day; is less than standard now, but alarms or sirens have more than 120 dB, other noises from their automobile and other exposures simultaneously had been effect on firefighters hearing.

National institute on safety and health had studied on firefighters in 1980.

Fifty three from 55 firefighters had some degrees of hearing loss because they had not worn personal protective devices.<sup>[6]</sup> In 1981, this Institute in other study had shown that 5 firefighters with 30 years occupational history had hearing loss, threshold was about 61.8 dB in 6000 Hz and these results had demonstrated the importance of attention to auditory system in firefighters in periodic examinations. In 1994, National institute on safety and health had shown the relation between duration of noise exposure and occupational hearing loss.<sup>[6]</sup>

In 2001, Kales SN. Freyman RL. Hill JM. *et al.* had demonstrated progression of hearing loss in firefighters, this study had been emphasized on audiometry in periodic examinations.<sup>[7]</sup>

In 2007, Ide C. had done a study on firefighters and had shown that firefighters had more progressive hearing loss in both ears and this disorders were caused some kinds of work accidents.<sup>[8]</sup>

In 2008, Clark W.W had shown the effect of occupation on firefighters' hearing after the elimination of age effect.<sup>[9]</sup> In 2008, Hong O. had demonstrated the positive attitude of firefighters could have a positive effect on reduction of hearing loss and attract them to use personal protective devices.<sup>[10]</sup>

The objective of this study is comparison between sensory neural hearing in firefighters and office workers.

## METHODS

Method of study; this is a cross-sectional study with two groups for comparison. Population of study; with  $\alpha=0.05$ ,  $\beta=0.80$ , population were 100 person in each group.

Exposure group or firefighters were about 100 person and non-exposure group or office workers without firefighting history were about 100 too. Method of sampling was random simple sampling for firefighters and office workers from firefighting organization with personnel number and matching.

Two groups were matched for age, smoking, diabetes, hypertension, cardiovascular diseases.

Data had been gathered from clinical–health issues of personnel without previous disease of ear and hearing. For validity and reliability of research tool; checklist have been written and improved in educational department, it had pilot study with correlation coefficient of 85% and it have been tested.

Main data are hearing threshold in 500, 1000, 2000, 3000, 6000, 8000 Hz and notch on 4000 Hz.

Other variables were age, smoking, work duration, diseases, protective devices for both groups which were acquired from clinical – health issues.

Tools for data gathering: checklist for clinical-health issues from audiometry results with CCA-220 industrial audiometer.

Many of the firefighters were below 40 years of age and these are out of the presbycusis definition, but we can reduce 0.5 dB for each year after than 40 years of age.<sup>[1,2]</sup> After that split file for below 40 years of age for elimination of age effect. Impairments were calculated with formula: Mean of hearing threshold in 500, 1000, 2000 and 3000 were calculated and then were reduced from 25 and multiplied to 1.5.<sup>[1,2]</sup>

Inclusion and exclusion criteria: Inclusion criteria are firefighting with at least 1 year occupational history, and administrative personnel for non-exposure group have too. Exclusion criteria for both groups are auditory system disorders.

Method of data analysis; Data analyzed in SPSS 11.5 with using frequency, mean, T-test; for comparison between quantitative variables, Chi-2 for comparison between qualitative variables with significance level  $P<0.05$ .

Research ethics; this study has been approved by university board.

## RESULTS

Mean age of firefighters was  $35.77\pm 8.87$  years and in office workers group was  $35.77\pm 8.97$  years with  $t=-0.349$  and  $P=0.728$ , there were no significant difference.

Mean age of firefighters work duration was  $9.05 \pm 6.62$  years and in office workers group was  $6.97 \pm 7.45$  years with  $t=2.085$  and  $P=0.038$ , there were significant difference. Table 1 demonstrates comparison between mean of hearing threshold in 500 to 8000 Hz in firefighters' right and left ear and office workers. It did not show the significant difference in all frequencies ( $P < 0.05$ ).

In office workers group, we had 23 women and 77 men. Firefighters were men; there were significant difference. One of the office workers had diabetes, but had normal hearing.

According to references, formula used for elimination of age effect, we should reduce 0.5 dB for each year after 40 years of age, after that it did not show the significant difference in all frequencies.

Comparison of two average ages had not significant differences, however after the split file for age 40 years of age or less than it, we repeat the T-test between two groups.

Table 2 demonstrates the comparison between mean of hearing threshold in 500 to 8000 Hz in

firefighters' right and left ear and office workers in 40 years of age and less than it. In 4000 Hz, the mean of hearing threshold in firefighters' right ear was  $20.51 \pm 10.11$  dB and in office workers was  $17.50 \pm 5.28$  dB. It showed the significant difference in 4000 Hz in firefighters' right ear and office workers with  $P=0.033$ .

None of the firefighters wore earplugs. According to formula; mean of hearing impairment in firefighters' right ear was  $29.83 \pm 34.51$  dB and in office workers' right ear was  $25.90 \pm 13.65$  dB with  $t=0.861$  and  $P=0.391$  without significant difference. Mean of hearing impairment in firefighters' left ear was  $26.11 \pm 23.34$  dB and in office workers' left ear was  $27.72 \pm 21.14$  dB with  $t=-0.419$  and  $P=0.676$  without significant difference.

## DISCUSSION

Mean of hearing threshold in firefighters for some frequencies (500, 1000, 2000 and 3000 Hz) were normal but for others frequencies (4000, 6000 and 8000 Hz) especially 4000 Hz were higher than

**Table 1:** Comparison between mean of hearing threshold in 500 to 8000 Hz in firefighters' ( $n_1$ ) right and left ear and office workers ( $n_2$ ) ( $n_{1,2}=100, 100$ )

| Frequency (HZ) | Mean threshold Firefighters |             | Mean threshold office workers |             | T-test |        | Significance $P < 0.05$ |       |
|----------------|-----------------------------|-------------|-------------------------------|-------------|--------|--------|-------------------------|-------|
|                | Right                       | Left        | Right                         | Left        |        |        |                         |       |
| 500            | 14.20±5.76                  | 13.85±4.42  | 14.50±4.46                    | 14.60±4.24  | 0.412  | -1.220 | 0.681                   | 0.223 |
| 1000           | 14.35±6.14                  | 13.90±4.85  | 13.85±5.16                    | 14.05±5.89  | 0.623  | -0.197 | 0.534                   | 0.844 |
| 2000           | 14.65±7.59                  | 14.05±5.93  | 14/85±5/33                    | 15.05±5.92  | -0.215 | -1.193 | 0.830                   | 0.234 |
| 3000           | 15.55±8.37                  | 15.05±6.21  | 15.35±5.99                    | 15.65±6.14  | 0.194  | 0.687  | 0.846                   | 0.493 |
| 4000           | 21.60±11.32                 | 21.85±11.56 | 20.55±8.98                    | 20.55±8.90  | 0.726  | 0.891  | 0.468                   | 0.374 |
| 6000           | 21.35±11.12                 | 21.35±10.29 | 20.50±8.94                    | 20.65±9.17  | 0.267  | 0.508  | 0.552                   | 0.612 |
| 8000           | 20.40±13.47                 | 20.30±12.69 | 20.60±10.87                   | 22.65±14.55 | 0.386  | -1.191 | 0.908                   | 0.235 |

**Table 2:** Comparison between mean of hearing threshold in 500 to 8000 Hz in firefighters' right and left ear and office workers in 40 years of age and less than it ( $n_{1,2}=70, 70$ )

| Frequency (HZ) | Mean threshold firefighters |              | Mean threshold office workers |             | T-test |        | Significance $P < 0.05$ |       |
|----------------|-----------------------------|--------------|-------------------------------|-------------|--------|--------|-------------------------|-------|
|                | Right                       | Left         | Right                         | Left        |        |        |                         |       |
| 500            | 13.67±6.61                  | 13.01±4.66   | 13.33±2.95                    | 13.40±3.41  | 0.386  | -1.557 | 0.700                   | 0.578 |
| 1000           | 13.75±6.87                  | 13.01±5.04   | 12.19±3.05                    | 12.72±5.55  | 1.681  | 0.314  | 0.095                   | 0.754 |
| 2000           | 13.89±8.36                  | 13.01±5.99   | 13.33±3.08                    | 13.78±5.48  | -0.215 | -0.779 | 0.830                   | 0.438 |
| 3000           | 14.26±8.29                  | 13.45±4.51   | 13.63±3.10                    | 14.24±5.63  | 0.194  | -0.894 | 0.846                   | 0.373 |
| 4000           | 20.51±10.11                 | 20.07±9.16   | 17.50±5.28                    | 17.87±6.62  | 2.153  | 1.585  | 0.033                   | 0.115 |
| 6000           | 20.36±10.34                 | 19.70±7.91   | 17.50±5.28                    | 17.87±6.62  | 2.012  | 1.447  | 0.046                   | 0.150 |
| 8000           | 17.35±11.14                 | 16.76 ± 8.62 | 17.50±7.08                    | 19.09±12.08 | -0.091 | -1.285 | 0.928                   | 0.201 |

normal and it was a beginning of occupational hearing loss in this group.

According to results; work duration of two groups had significant difference ( $P=0.038$ ). But the means of age were less than 40 years of age, without significant difference ( $P=0.728$ ).

Means difference between two groups were not significant except hearing threshold in 4000 Hz for right ear in person with 40 years of age or less than it ( $P=0.033$ ), firefighters' right ear had higher threshold in 3000, 4000 and 6000 Hz than office workers and firefighters' left ear had higher threshold in 4000 and 6000 Hz than office workers with attention to notch in 4000 Hz.

Means difference of hearing threshold between low and high frequencies had no significant difference, but the difference was more in high frequencies with much of hearing threshold in firefighters.

National Institute on safety and health demonstrated that more than 95% of firefighters had some degree of hearing loss and had not earplugs.<sup>[11-13]</sup>

In our study, firefighters did not use earplugs and had some hearing loss in 4000 Hz. Table 2 showed its difference with  $P=0.033$  for right ear.

In 1981, this institute demonstrated severe hearing loss at 6000 Hz in 5 firefighters with 30 years work duration, and this result shows more attention to periodic examinations.<sup>[6,14]</sup>

Kales SN, Freyman RL, Hill JM, *et al.* had shown the progressive hearing loss in firefighters and made special attention to audiometry. Our study demonstrates the beginning of hearing loss in 4000 Hz and we think that the audiometry is necessary for firefighters' periodic examination.<sup>[7]</sup>

National Institute on safety and health demonstrated that having more work duration; will have more hearing loss. Our study had found the correlation between work and hearing loss.<sup>[6]</sup>

Ide found that firefighters had more deep and severe hearing loss than other workers and it was caused of work accidents.<sup>[8]</sup> Clark demonstrated after elimination of age effect; occupational effect on hearing loss showed itself,<sup>[9]</sup> also our study showed some occupational hearing loss too. Hong showed that positive attitude of firefighters could have an effect on their usage of earplugs.<sup>[10]</sup>

## CONCLUSION

In this study that mean of hearing threshold in firefighters for low frequencies are normal but for high frequencies in firefighters especially 4000 Hz are higher than normal and is a beginning of occupational hearing loss.

We suggested that the place of alarm or siren must be changed and should not be near the skulls, and usage of earplugs or earmuffs and getting audiometry in pre-placement and periodic examination of firefighters is necessary.

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## ERRATUM

### ORIGINAL ARTICLE

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**Title: The Role of Maternal Thyroid Stimulating Hormone Receptor Blocking Antibodies in the Etiology of Congenital Hypothyroidism in Isfahan, Iran**

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*Should read as*

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The error is regretted  
- Chief Editor, IJPVM