Study on Hearing Ability and its Relationship to Noise Levels in an East London Factory*

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Summary
This paper describes an investigation into hearing ability in a group of workers in noisy surroundings and in two control groups. Although the results are not statistically significant, the study illustrates the value of pre-employment and regular audiometric testing in industry.

Introduction
At the beginning of 1979, an East London factory with 354 employees, processing edible oils and fats for the confectionery and food industries, embarked on a programme of noise reduction in all areas of the factory. This involved the adaptation of existing machinery and only ordering new equipment producing no more than 78 dB(A) from a single machine. Sound havens and ear defenders would be supplied as interim measures.

It was decided to take baseline readings of noise levels and hearing ability in an attempt to correlate excessive noise exposure with deafness and identify groups of workers especially at risk.

Materials and Methods
Three areas in the factory were considered to be 'noisy'—the boiler house and two fractionation plants. The remaining areas, for example, the warehouses, general yard, refinery, laboratories and canteen, were thought to be 'not noisy'. All the 41 men working regularly in the 'noisy' areas were invited by the medical department to take part in the study. Those who agreed were matched with men of the same ages picked at random from the 'not noisy' areas and with a second control group of the same ages picked at random from a city head office. The head office group consisted of 1021 male employees ranging from catering and service personnel, through clerical and engineering staff, to managers, all living within a 50-mile radius of London and thought to represent the general population. All participants were offered a preliminary ear inspection, together with syringing to remove wax if necessary. They were then offered six dates to attend for an audiometric test followed by a private consultation with an ear, nose and throat consultant if deemed necessary and if agreed by the individual's general practitioner. Arrangements were made to exclude workers in the 'noisy' areas from noise exposure at work for 48 hours prior to audiometry. In all, 28 men agreed to take part and therefore 84 men were included in the study.

It was decided to ask an unbiased hospital department to conduct the audiometric tests and Mr A. W. Morrison, consultant ENT surgeon at The London Hospital, kindly agreed to read the audiograms and to investigate any person he thought might benefit from ENT treatment. His technicians at the Audiology Department at The London Hospital took manual readings with a Peters audiometer under standard conditions. They were not informed to which group each man belonged.

While the hearing study was in progress, dB(A) levels were monitored in the 'noisy' areas. There were 112 noise monitoring points in the boiler house and fractionation plants and the dB(A) levels were recorded at each point on three occasions, several days apart. The dB(A) levels were recorded with a Bruel and Kjaer Precision Sound Level Meter. Average dB(A) levels for each area were noted on the three occasions and the highest dB(A) levels obtainable in each area were also noted.

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Average dB(A) levels in the boiler house and fractionation plants were as follows: scatter of readings 70.0-90.0 dB(A) (1 elevated by a steam leak), mean = 85.9 dB(A); Highest dB(A) levels in the boiler house and fractionation plants were: scatter of readings 78.0-98.0 dB(A), mean = 92.9 dB(A).

A more valuable method of assessing noise exposure to individual operators and foreman would be the dosimeter, but unfortunately this was recording inaccurately at the time of the study. The recommended maximum L eq level for a basic 8-hour shift is 90 dB(A), ranging from 96 dB(A) for 2 hours continuous noise exposure to 87.4 dB(A) for 16 hours. The maximum permitted continuous sound level is very likely to be reduced to 85 dB(A), or lower, to accord with other European countries and the USA when agreement on the level can be reached.

Results
The results of the audiometric tests are shown in Table I. Individuals working in 'noisy' areas comprised group A, individuals working in 'not noisy' areas group B and control group of office workers group C.

The age range in group A was 20-63 years, mean 42 years and length of service at the factory 1-20 years with a mean of 7 years. Thirteen men who were not willing to take part had an age range of 26-57 years with a mean of 45 years and had a length of service of 2-23 years, mean 11 years. The age range among the normal audiograms in group A was 20-63 years, mean 33 years; length of service was 1-20 years, mean 7 years. Among the abnormal audiograms in group A the age range was 31-63 years, mean 48 years, and the length of service 1-20 years with a mean of 6 years.

Table II. Medical conditions diagnosed in the course of the study

<table>
<thead>
<tr>
<th>Condition</th>
<th>Cases*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acute otitis media</td>
<td>3</td>
</tr>
<tr>
<td>Old middle ear disease/perforated tympanic membrane</td>
<td>3</td>
</tr>
<tr>
<td>Familial deafness</td>
<td>2</td>
</tr>
<tr>
<td>Eustachian insufficiency</td>
<td>1</td>
</tr>
<tr>
<td>Chronic discharge following mastoid operation 28 years previously</td>
<td>1</td>
</tr>
<tr>
<td>Hereditary strial degeneration</td>
<td>1</td>
</tr>
<tr>
<td>Bilateral otosclerosis</td>
<td>1</td>
</tr>
</tbody>
</table>

*One case is still undergoing investigation for severe bilateral hearing loss associated with vertigo and nystagmus.

Medical conditions diagnosed in the course of the study are shown in Table II. The diagnosed cause of abnormal audiograms in all three groups is given in Table III. The medical cause alone group consisted of 5 fairly minor disabilities due to old or current infection or familial deafness and 2 very severe cases of deafness due to old disease and heredity. The group comprised 3 from group A, 2 from group B and 2 from group C.

The noise exposure alone group surprisingly contained none from group A, but 4 from group
B and 3 from group C. The disability in this group was mild to moderate high tone deafness maximal at 4000 Hz. Five of the 7 had been in the RAF exposed to jet and bomber noise; 3 had taken part in machine gun fire during the war and it was possible to identify whether they fired right or left-handed from the ensuing deafness. Only two had also had noisy jobs in the past, one in the boilerhouses and the other as a rivet boy. None had worn ear protection.

The combined medical and noise group comprised 3 from group A and 3 from group B. Two had minor hearing loss, 2 moderate and 2 very severe. Four had been exposed to heavy gunfire during National Service, 4 had mild otological conditions, 2 had had noisy jobs, one in ship repairs and one in this factory, and 2 men had severe but potentially treatable ear conditions which were previously undiagnosed.

The uncertain group consisted of 2 from group A and 2 from group B. All had mild to moderate, deafness with no evidence of past or present ear disease and no typical 'noise-exposure pattern' on the audiograms.

Of all the medical causes, 6 men were considered eligible for and received appropriate treatment. All the men with hearing loss of any degree were advised as to the cause and future prognosis; 2 men were advised to have annual follow-up audiometry, 2 others were advised against any further exposure and 1 man is still undergoing investigations.

Conclusions
I am assured that the numbers involved are far too few to be of statistical significance in correlating noise exposure and deafness. The variables of blood pressure, presbyacusis and individual susceptibility all play a part in the results. Also the particular type of audiometer used appeared to give normal audiograms, but 10 dB(A) below the national average with a fall of 20 dB(A) at 250 Hz.

Nevertheless, as an exercise in occupational medicine, several conclusions can be drawn.

1. The average noise levels in the factory are at present just within the current recommended limit in the ‘noisy’ areas but will not conform to the expected new level of 85 dB(A).
2. Audiometric tests on a group of working men produced almost 30 per cent abnormal results, most of which were unsuspected previously and 6 of the 84 men received medical treatment which they may otherwise have missed.

3. The mean length of service of group A individuals in the factory is approximately the same in the group as a whole, in those with normal audiograms and in those with abnormal audiograms. However, the mean ages would imply that any abnormalities in the audiograms are rather related to the changes associated with increased age, than to working in the factory.
4. At least 3 had conditions which are presumed to have caused moderate deafness before they started work in ‘noisy’ areas of the factory. These men would be less able to recognize unusually high noise levels than their colleagues and would therefore be at greater risk of further damage.
5. The mean ages and length of service are higher in those who declined to participate than in those who took part in the study. This could mean that older men with a longer history of noise exposure are less keen to know about hearing disability in case they are moved from the more lucrative shift work to a quieter environment in the factory.
6. National Service appears to have done considerable disservice to many of its participants in terms of hearing loss.

Recommendations
The programme of noise reduction in the factory should continue. All employees who are expected to start work in sound levels approaching or above 85 dB(A) continuously should have audiometric tests before they begin. Men with normal audiograms in these circumstances should be followed up 3 yearly. Men with abnormal audiograms should either be diverted to another occupation or provided with effective hearing protection and followed up annually. Men in whom serial audiograms show a deterioration should be investigated medically, diverted to another occupation or provided with effective hearing protection and followed up 6 monthly.

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BIBLIOGRAPHY


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Occupational Hygiene


This important new book presents a clear and concise account of the principles of occupational hygiene. It has been written by widely-acknowledged experts whose considerable experience of the working environments they discuss lends authority to the text. Although the book has been written principally for students of occupational hygiene, there is much in it that will interest occupational physicians and nurses, and trade union safety representatives. The book has no rival and should become established as the standard work on the subject; it will in any case provide those who use it with a text that is both stimulating and informative.

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