THE IMPLICATIONS OF THE ARMY'S AUDIOMETRIC SCREENING PROGRAMME

PART II—HEARING ACUITY IN BRITISH ARMY RECRUITS

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SUMMARY: An audiometric survey of a random sample of sixty officer recruits and six hundred adult and junior soldier recruits showed that 6.7 per cent of the soldier recruits and 3.3 per cent of the officer recruits had hearing losses which would make their application to become military recruits unacceptable if the losses had been identified at their pre-service medical examination.

The use of a simple noise questionnaire was shown to have no predictive value as an indicator of the presence of hearing loss in any particular group of recruits.

A follow-up of adult soldier recruits after completion of their basic soldier training showed that there was no requirement to repeat the audiometric examination in the recruits post-basic training medical examination.

Introduction

In the Army's audiometric screening programme it is intended to carry out screening audiometry on officer recruits at the Army Medical Board which follows the recruit's provisional acceptance for a place at the Royal Military Academy (RMA), Sandhurst. This will be achieved using self-recording audiometry.

Screening audiometry on soldier recruits is to be carried out at the pre-service medical examination arranged by Army Careers Information Offices (ACIOs). This is usually achieved by means of the forced whisper test, as very few ACIOs possess their own screening audiometry. Definitive base-line audiometry is planned to be carried out on soldier recruits using self-recording audiometers when they arrive at their recruit training establishments.

In view of the current limitations on time allotted for medical examinations at these establishments, particularly when there are large intakes several times a year, the administration and recording time of 10-12 minutes for each self recorded audiogram will make it virtually impossible to carry out the required number at these locations.

Even if the immediate problems were to be alleviated by a more generous allocation of time, combined with provision of extra audiometers and staff trained to operate them, there will still be a number of recruits with unacceptable hearing levels who will reach the recruit training establishments before this impairment is recognised. This number is unknown at present, but it is particularly important in the case of adult soldier recruits who are paid from the day they are enlisted at the Recruit Selection Centre (RSC), Sutton Coldfield, and who can cost the Army nearly £60 a day¹ when training and support costs are included.

It would assist the audiometric screening programme if a simple noise ques-

ionnaire could be used to indicate a particular group of individuals, who through previous industrial or weapon noise exposure or through their social class, might be predicted to have unacceptable hearing losses.

In addition, little is known about the effects on recruit hearing of exposure to hazardous noise during their basic soldier training in this country. The training varies from 10 to 20 weeks duration depending on which Arm or Corps the recruit joins, and the amount of weapon noise to which the recruits are exposed during the training clearly varies. However, all recruits do the same minimum of small arms firing during their basic training and there may be a requirement to repeat their audiometric examination after the basic training is completed.

The present study was therefore set up to survey the hearing levels of a sample of recruits, all of whom had been accepted for recruit training, both before and after the basic training course.

Methods

The study was carried out at RMA Sandhurst on a random sample of sixty officer recruits from a Standard Military Course and a Direct Entry Course, at RSC Sutton Coldfield on three hundred adult and young soldier recruits (aged 17 years+) selected for basic soldier training, and at the Army Youth Selection Centres at Harrogate and Deepcut on three hundred junior soldier recruits (aged 15 to 17 years) who had been allocated places at Army Apprentice Colleges or Junior Leader Regiments.

Tracor Rudmose ARJ-4C self-recording audiometers were used throughout the survey, the earphones and audiometers being calibrated monthly to maintain accuracy in the survey.

All subjects were interviewed by the author prior to carrying out their audiograms, and a questionnaire was completed which recorded information on the subject's date of birth, social class, previous industrial and weapon noise exposure, recognition and management of any hearing loss, and the results of the analysis of the audiograms recorded in the survey. All subjects' ears were examined clinically by the author before the hearing test and if a remediable hearing problem was discovered the individual was directed to the supervising medical officer for treatment or referral to a hospital orthorhinolaryngology (ORL) department.

Conduct of the survey and analysis of the audiograms were the same as that used in the study of serving Infantrymen reported earlier in this journal.

Audiometric follow-up of all subjects who appeared to require classification as H3 or worse (unacceptable for most employments in the Army) was attempted. However, because of problems in obtaining ORL outpatient appointments at civilian hospitals within the time-scale of the survey, this follow-up was not completed.

One hundred and forty adult soldier recruits with H1/H2 hearing were nominated for audiometric follow-up at recruit training establishments after completion of their basic soldier training. Twenty-two were lost to follow-up because of discharge from the Army during the recruit training period. The remaining one hundred and eighteen subjects were followed-up audiometrically using a Tracor Rudmose ARJ-4C self-recording audiometer, as before, either by the author or by a member of the medical centre staff at the training establishment.

Any individual found to have a deterioration of hearing level of greater than 10dB was again interviewed, either by the author or the recruit's unit medical officer. At this interview a detailed history was taken from the soldier concerning noise exposure and the wearing of hearing protection during his basic training. The subject's ears were again examined clinically and a further audiogram was recorded to confirm that this was a genuine hearing deterioration which could be reasonably attributed to military noise exposure.

Results

The audiograms were analysed in two ways. Firstly, by PULHEEMS hearing classification (Table I) and secondly, by hearing loss of greater than 30 dB in a

Table I
Hearing classification of 660 recruits by recruit type
after the audiometric survey

Classification	Junior	Adult	Officer	Totals
H1	270	273	56	599
2	10	7	2	19
H3	14	13	1	28
4	5	4	0	9
5	0	1	0	1
6	0	2	1	3
8	1	0	0	1
Totals	300	300	60	660

low frequency grouping (0.5, 1 and 2 kHz) and a high frequency grouping (3, 4, 6 and 8 kHz). The second analysis is shown at Table II.

Table II
Audiometric classification of 660 recruits by recruit type
after the audiometric survey

Classification	Junior	Adult	Officer	Totals
Hearing loss <30 dB at any frequency	242	252	54	548
Hearing loss >30 dB in frequency groups:				
0.5 — 2 kHz	11	7	0	18
3 — 8 kHz	31	32	5	68
In both groups	16	9	1	26
Totals	300	300	60	660

Forty-two (6.4 per cent) of the whole sample recorded hearing levels in the survey which would place them in a hearing category of H3 or worse ("positives"). This breaks down to 20 (6.7 per cent) each for junior and adult soldier recruits, and two (3.3 per cent) for officer recruits.

Of the 20 adult soldier recruits who were classified as H3 or worse, follow-up at an ORL department was achieved on only 14. Six of these were confirmed as

H3 or worse, and eight were upgraded to H1 or H2. On this limited follow-up, therefore, forty-three per cent of the positives were likely to be confirmed as having hearing levels which would place them in a hearing category of H3 or worse.

One hundred and twelve (17 per cent) of the recruits showed a hearing loss of greater than 30 dB at one or more frequencies between 0.5 kHz and 8 kHz in the screening survey. In an attempt to explain the losses and pinpoint a high risk group of recruits, cross-tabulation of the numbers with hearing loss in the 3-8 kHz frequency range against previous exposure to industrial noise and previous exposure to weapon noise was carried out for the three groups of recruits separately. No significant association between the two variables could be demonstrated in either case for any one of the recruit groups when tested by the chi-squared test.

Similarly no significant association could be demonstrated between the numbers with hearing losses in the 0.5-2 kHz and 3-8 kHz frequency ranges when cross tabulated with the social class distribution of the whole sample and tested by the chi-squared test.

In the sub-sample of 118 recruits followed up after completion of their basic training, none suffered a hearing loss in the 1 to 4 kHz frequency range sufficient to change their PULHEEMS hearing classification to H3 or worse.

However, sixteen (13.6 per cent) of the sub-sample recorded a deterioration of hearing level at 6 or 8 kHz of greater than 10 dB, and half of these sixteen (6.8 per cent of the sub-sample) recorded a deterioration of greater than 20 dB at these frequencies. None recorded a deterioration of hearing level greater than 30 dB.

Discussion

Analysis of the audiograms from the sample of recruits showed that 6.7 per cent of the soldier recruits and 3.3 per cent of the officer recruits recorded hearing levels in the survey which would place them in a category of H3 or worse. This would make their application to become Army recruits unacceptable under normal circumstances. Over the period of the survey, a Ministry of Defence investigation² showed that 130 (0.5 per cent) of the total recruit applicants had been rejected at the pre-service medical examination because of "ear problems" including deafness. Obviously only a very small proportion of the applicants with hearing impairment are being picked up at this medical examination.

The survey findings are very similar to those found by Coles³ in his audiometric survey of applicants for service in the Royal Navy, which showed 6.5 per cent of ratings and 2.8 per cent of officer candidates would be rejected because they could not meet the required hearing standards. However, Coles' survey was carried out at a Royal Naval Careers Office before the applicants were accepted for service, whereas the present survey was taken after the subjects had been accepted for recruit training.

If the figure of 20 (6.7) per cent of the adult soldier recruits in the sample who recorded unacceptable hearing levels is projected to the whole annual adult soldier recruit intake of 14,000, there could be over 900 individuals each year who should have been rejected at an earlier stage or referred for an ORL specialist opinion.

The follow-up study indicated that 43 per cent of these would be confirmed

as being in a hearing category of H3 or worse, which suggests that up to 400 individuals out of the total annual adult soldier recruit intake could require discharge from the Army during recruit training because of unacceptable hearing levels.

If it is assumed that each of the adult recruits would stay in the Army for at least two weeks before discharge at an estimated cost¹ of £57.18 per day (including pay, training and support costs), then even the lower number of 400 adult recruits applied to the cost for fourteen days gives a figure of around £320,000 a year that could be wasted on these discharged recruits.

This is likely to be the minimum estimate when the time taken to arrange, complete and report on an ORL out-patient appointment, the time taken to carry out and complete a medical board, and the time taken subsequently to discharge the soldier can be several weeks.

All this supports the view that audiometric screening of applicants for the Army should be carried out as early as possible after the individual's first appearance at the ACIO. Any individual with suspect hearing can then be retested at a later date before further commitment by either side. If the hearing loss persists, then an ORL specialist's opinion can be sought before acceptance or rejection of the applicant. The three options for the earlier assessment of a potential recruits hearing are shown at Figure 1.

The first option of carrying out the audiometry at ACIOs can be ruled out on cost alone. There are one hundred and seventy ACIOs in the United Kingdom, varying from the very large to the very small, and most of these would have to be equipped with an audiometer if a high percentage of recruits was to be tested. In addition, the Royal Navy⁴ are already carrying out screening audiometry at their Careers Offices, but find it unsatisfactory through excessive background noise, lack of space for installation of a sound-proofed booth or other quiet room, and inconsistency of technique between operators.

The second option of carrying out the audiometry at Regional Medical Centres is certainly the most attractive. All officer and soldier recruit applicants would be referred to these boards from the ACIOs and the RCB for their screening audiometry, probably as a part of the pre-service medical examination. The boards could be based on existing service medical centres, but there are problems in the recruitment of medical officers to fill the vacancies created, and in potential recruits having to travel some distance for their medical examination. It is understood, however, that a Director of Army Training Study is investigating the feasibility of centralised recruit training again, and a Management Services Organisation (Man S Org) study is investigating the feasibility of regional medical centres, so a decision on this option must await the outcome of these studies.

The third option of carrying out the audiometry as RSCs and AYSCs has some merit, but would require considerable expenditure to provide or expand the medical staff and facilities at each location. It also has the disadvantage of not covering soldier re-enlistments who form about 3 per cent of all Army new entrants. They could be a vulnerable group through acoustic trauma suffered during their previous Army service.

In the study, no statistically significant association could be found between

Fig. 1 Options for Relocation of Recruit Audiometry

hearing losses and previous exposure to industrial or weapon noise amongst the three groups of recruits, or between hearing losses and the social class groupings of the whole recruit sample. The survey by Richardson and his colleagues⁶ has shown that hearing levels in the children of manual workers were appreciably worse than those of non-manual workers, and the gap widened at 16 years compared with thresholds measured on the same children at 7 years and 11 years. The difference in the findings may be due to the much smaller hearing losses recorded in their survey compared with the 30 dB threshold used in the present survey, and the grouping of their subjects into large purely manual and non-manual groups in the analysis.

None of the one hundred and eighteen adult soldier recruits with normal (H1/H2) hearing who were followed up after basic soldier training suffered a hearing loss during that training sufficient to change his PULHEEMS hearing classification to H3 or worse. This confirms that there is no need for a post-basic training audiometric examination.

However, the fact cannot be ignored that eight of the recruits recorded a deterioration in hearing level of between 10-20 dB, and a further eight recruits a deterioration of between 20-30 dB in one or both ears in the 6 or 8 kHz frequencies. They will require regular audiometric follow-up to monitor any further deterioration in hearing levels at those higher frequencies, so that appropriate action can be taken to remove them from further hazardous noise exposure. These sixteen subjects could represent those recruits with ears sensitive or sensitized to weapon noise who are beginning to develop acoustic trauma as early as recruit training.

A prospective audiometric study of a fresh cohort of adult soldier recruits, possibly infantry recruits with a high rate of exposure to weapon noise, could provide valuable information on the natural history of acoustic trauma in the Army.

Implications

The first major implication is that recruit audiometry should be removed from recruit training establishments and carried out earlier in the recruit selection process. It would appear that the ideal solution would be to carry out recruit audiometry at regional medical boards, probably as part of the pre-service recruit medical examination. This is under investigation at present, but there is a need for a pilot study to be set up in conjunction with the Directorate of Army Recruiting, based on a Central London military medical facility, to assess the feasibility and acceptability of this concept of recruit medical examination.

Secondly, although there is no apparent requirement for a post-basic training audiometric examination of recruits, a long term prospective cohort study of recruits is required to investigate the epidemiology of acoustic trauma in the Army.

Thirdly, a simple noise questionnaire of the type used in the survey is of no value as an indicator of the possible presence of hearing loss in a particular type of recruit, and has no place in the military audiometric screening programme.

Finally, as was found in the study of serving Infantrymen, a single audiogram screening programme identifies a large number of false positives (those recruits identified as H3 or worse who are subsequently shown to be in a better hearing classification). Only a combination of careful clinical follow up and repeat audiometric examination, at the medical centres carrying out recruit audiometry, will prevent an unnecessarily heavy work-load descending on military ENT departments.

Conclusions

The survey has shown that an unnecessarily large number of recruits are arriving at recruit training establishments with unacceptable hearing levels. It is concluded that recruit screening audiometry should be carried out much earlier in

the recruit selection process, ideally at regional medical centres as part of a pre-service recruit medical examination.

There is no apparent requirement for a further audiometric examination of recruits at their service medical examination on completion of basic soldier training. However, further investigation of the natural history of acoustic trauma amongst recruits and serving soldiers is required.

A simple noise questionnaire has no place in the Army's audiometric screening programme, as a means of predicting those recruits who may have unacceptable hearing impairment.

Careful clinical follow-up will be required combined with repeat audiometric examination, to authenticate those recruits whose hearing is classified as H3 or worse before they are referred for an ORL opinion.

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