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Industrial Deafness Studies in Holland

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I. DEAFNESS IN INDUSTRY

Industrial deafness studies in Holland

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Introduction

In the Netherlands, Industrial Health Services have been run from the very beginning almost exclusively by physicians. It is not surprising therefore that our approach to the noise problem was and is confined largely to the hearing damage side.

In this paper two points are emphasized:

(1) The necessity for a long-term scheme of activities in research on industrial deafness. It is now less useful to speak about what we have been doing or do at present, than about the way we want hearing conservation practices to develop. In our Dutch working group on the 'Relation between Noise and Noise Deafness', we review our approach to this every year, taking into consideration our new data. We do not want to lose time by exploring details that may be interesting or more accessible to measurement, but hold no promise of practical procedures.

(2) We feel a strong need for cooperation, national and international, to avoid uncoordinated work and unnecessary duplication, in order to obtain results more rapidly and to improve cross-fertilization of ideas. This conference is a manifestation that you in Britain hold this same point of view, and we should like to examine your ideas about how to realize such coordination. In the Netherlands an attempt is made to coordinate all research on industrial noise effects by the Steering Committee on Noise of the Commission on Occupational Health Research T.N.O. (T.N.O. stands for 'Applied Scientific Research'). This research on industrial noise problems is done by some university clinics and institutes, some T.N.O. institutes (particularly the Institute for Public Health Engineering in Delft and the Institute for Preventive Medicine in Leiden), the governmental Inspectorate of Factories and some private industries through their Occupational Health Services.

Our programme

We all know that noise can be damaging to the ear. But which noise is damaging and what handicap this damage causes is still insufficiently known. When looking for an answer to these questions, the research worker might be careful not to spend too much time on details, if these do not bring the main problem nearer to a solution. In practical circumstances a quick though approximative answer often is of more value than the exact answer after many years.

Our programme of research consists of several separate subprogrammes. Some of these subprogrammes are finished already, others are in full progress and the remainder are not yet started.

The ideal objective of our research programme could be: finding a sufficiently exact relation between noise measurements and the percentage of people that will sooner or later develop a certain amount of hearing loss by being exposed to this noise. Preferably

this should be known for continuous and for intermittent noise exposure, for workers in a fixed working place and for ambulant workers, for men and for women, for all relevant age-groups and further as a function of the duration of the exposure.

When we have found all these relations, we can predict hearing loss distribution in a group of persons but we cannot hope to say anything about the individual loss. To ascertain this loss, we must employ preventive audiometry. Nevertheless, knowing the relation between noise and hearing loss could be of great use if, for instance, it could be concluded that in a given circumstance even in the long run practically nobody would get more than a small and acceptable threshold deviation (e.g. 15 dB). This would make audiometry superfluous in the circumstance.

We therefore still aim at finding these relations, but in first instance we restrict ourselves to studies of continuous exposure to constant broadband noise. This restriction still leaves us to establish noise levels and the frequency distribution of the spectrum. And on the hearing side these two questions remain: what does 'practically nobody' mean, and what is an 'acceptable threshold deviation'?

Damage risk criterion

As a damage risk criterion we provisionally took one, which is under discussion at the International Organization for Standardization (Technical Committee 43), the so-called noise rating curve 85. For our own instruction and to test this criterion, we collected all Dutch noise spectra and group-audiograms that were made available to us (T.N.O. 1963). Because the hearing loss distribution at higher frequencies tends to be skew and because exact threshold determinations at levels of 10 dB or less are seldom trustworthy or necessary in industrial audiometry, we put forward the use of the median and quartiles (or other percentiles) and discourage the use of the mean and standard deviation.

We made this inventory available to industry as a source of information.

Audiometry in industry

In order to obtain more data, we started an audiometric survey in industries having continuous noise with spectra within ± 10 dB around noise rating 85. Some of our results are included in the paper by Passchier-Vermeer (this volume, p. 273). To speed up this survey, we have attempted to obtain cooperation from other industrial health services. To this end we have up until now issued two forms of recommendation, one on the measurement of sound in industry (T.N.O. 1966) (from the medical implication viewpoint), the other on industrial audiometry (T.N.O. 1962). Other recommendations, for instance on screening, may follow. As we need comparable results from all cooperating bodies we furthermore initiated a 2-week training course on audiometry for industrial health-service assistants, a routine procedure for testing audiometers and a method for mechanical treatment of our data.

Additional problems

Apart from collecting reliable data on noise and hearing thresholds, several problems must be taken into consideration before we can indicate a noise limit. Some of these problems are:

(1) Variability of threshold determination inherent in the method, the operator and the instrument.

(2) Variations of hearing, independent of noise exposure.

(3) The threshold distribution, that can be called 'normal' for similar groups from the population that had no noise exposure (particularly age-groups).

(4) The moment the audiogram can or should be made (before, during or after work, and, if after, when?)

(5) What correlation exists between social handicap and hearing damage?

Variations inherent in instrumentation, etc.

We tried to minimize the first two of these parameters by giving a standardized specification for the audiometers, and strongly recommended and provided a practical training course for one well-defined method of audiometry for which we took the so-called continuous or sweep-frequency method. In this method thresholds are determined by sweeping a test tone, which is fully variable between 200 and 8000 Hz at a constant level (in dB) above the normal threshold curve, through the whole sweep. Thus, thresholds are found not by going vertically through the audiogram, but by going horizontally.

We have chosen this method on account of the ease and the rapidity in determining position and width of dips, even if small, as with early noise damage.

Van den Eijk investigated the variance of threshold determinations using this method, and his ten subjects had various threshold deviations. As yet we only have the data of one and the same audiologist examining ten persons, each ten times on different days. We aim at having different audiologists examining the same subjects. Results up till now are comparable to those of Atherley & Dingwall-Fordyce (1963).

Screening

Examining an industrial population with a sweep-tone from 1000 to 8000 Hz at 20 dB above normal threshold, enables us to find deviations anywhere in this area of about 25 dB or more. As a monitoring test for small dips this is superior to the 4000 Hz single frequency test, because the maximum loss is often at a frequency other than 4000 Hz. In our material (van Leeuwen & van den Eyk 1963) more than 5% of people with dips of 31 to 40 dB could hear a 4000 Hz tone at 15 dB above normal threshold; so the investigator would not have found their dip. Nevertheless, a 4000 Hz threshold determination of all workers in a noisy department can be useful as amethod to get information on the amount of damage in that department.

Age effects

In order to know what part of any hearing loss could be called noise-induced, Spoor (1967), in a critical survey, compiled normal thresholds at different age-groups from reliable data in the literature.

Industrial speech audiometry

As the social function of the ear is primarily the hearing of speech, investigators are proceeding on the relation between threshold deviations and the results of speech audiometry. It is hoped that a method of assessing auditory social disability will be evolved which can be conveniently used by every industrial physician, and also as part of a speech

audiometric examination in an ear-nose-throat clinic. In our industrial set-up, designed by Groen, a background noise is used to introduce a cocktail party effect, which has the additional advantage of masking other extraneous interfering noises.

Temporary threshold shift

An important question in industrial audiometric investigations is: at what moment should the audiogram be made? This depends on what one wants to know. In a legal or insurance case, several noise-free days or weeks and repeated audiograms are necessary. But when an industrial physician wants to know what damage he may expect if no noise attenuation or hearing protection is introduced, he may as well perform his examinations during or at the end of the working day. In my opinion the sum of permanent damage and temporary threshold shift (t.t.s.) at the end of a working day give an indication of the permanent loss we must expect in a group, if continued to be exposed to the same noise. All the same, we still want information on the exact course of the t.t.s. It is not reasonable to judge the social disability when all t.t.s. has disappeared, if during a considerable part of the leisure hours it may still be present. Besides, it is important to know at what time of the day the t.t.s reaches the maximum that exists at the end of the day, as this helps when choosing the moment for making the actual audiogram.

Hearing protection

In parallel to the above runs the problem of the measures to take in protecting against damage. In connexion with this, two groups of Dutch investigators tested ten kinds of protective devices (van Laar *et al.* 1964). The principal reason for this was to know the attenuation values we could expect when the devices were used in industry. We have no need for maximum or mean values as given by manufacturers but for values that we can rely on in, for instance, at least 75 or 90 % of the wearers, depending on the severity of the damage that otherwise could be expected.

In this survey of what is being carried out in the Netherlands, I have tried to outline the way in which we tackle the problems. We shall be glad of any help and any critical comment to further the prevention of noise-induced hearing loss or, by chance, other noise-induced troubles. It may be useful to consider the possibilities of combining some of these activities.

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