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A SURVEY OF SOUND LEVELS IN DISCOTHEQUES - A PRELIMINARY REPORT

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Introduction

From the mid sixties onwards a number of researchers expressed concern about possible damage to hearing resulting from exposure to amplified music. This concern stemmed from the high sound levels experienced in premises where this type of music was played and the reported frequent attendance pattern of young people to such premises. This early work was admirably summarised by Whittle and Robinson (1974). The principal conclusion of this summary was that there was, as yet, no convincing evidence that pop music need be treated in any other way than industrial noise when seeking to evaluate the risk of hearing loss in populations exposed to such sounds. They did, however, identify two areas of the problem where information was lacking and which were crucial to a satisfactory evaluation of risk under the conditions they outlined, namely:-

(i) a knowledge of the behaviour pattern and attendance frequency at places in which amplified music was played, and
(ii) the need for more systematic and suitably documented information on the actual noise exposure during the session

After a small pilot study a survey programme was devised to evaluate the above areas of uncertainty. The project, which is sponsored by the Noise Advisory Council, commenced in January 1977 and will end January 1979. The results presented below represent the preliminary findings from the sound level survey conducted in 25 commercial and youth-group discotheques in the West Yorkshire area. The premises varied considerably in their size, layout and equipment and in the type of music played. In the youth-groups the music was played exclusively from recorded discs, whereas in the commercial premises it was usually a mixture of discs and live groups. The evaluation of exposure is being conducted concurrently with the sound level survey and the total survey will cover some 50 to 60 premises.

Method

The principal objectives in the sound level survey were:-

(i) to evaluate the range of 'A' weighted L_{eq}'s actually experienced by the exposed population
(ii) to determine the range of maximum 'A' weighted L_{eq}'s to which the attending populations could be exposed
(iii) to obtain information on the frequency spectrum and dynamic range of sound levels.

For objective (i) personal dose meters, CEL type 122 and B & K type 4424 were used by attenders with ½" microphones mounted on the collar. For (ii) a B & K Noise Analyser type 4426 with ½" microphone was placed at a position representing the highest 'A' weighted SPL to which the attending population could be exposed (referred to as the reference instrument). Additionally, for (iii), tape recordings were obtained for subsequent analysis. Spot levels

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were also obtained using a precision sound level meter. Readings were obtained from the dose meters at approximately half hour intervals and from the noise analyser, via the associated printer, at 10 minute intervals over the whole period of the event, which varied between 2 and 6 hours. The noise analyser was programmed to read L_1, L_5, L_{10}, L_{50}, L_{90}, L_{95}, L_{99} and L_{eq} and the sampling rate was set at 0.2 sec. or 0.5 sec. depending on the duration of the event.

Results

Dose Meters: Ninety measurements from the dose meters were obtained and the distribution of these results are shown in Fig.1. The mean value is 94.5 L_{eqA}, with a S.D. of 3.8 dBA. Results from the variation of L_{eqA} with time are not presented in this paper.

Noise Analyser: The grouped results of the L_{eqA} measurements are shown in Fig 2. The mean value is 100.9 L_{eqA} with a S.D. of 4.8 dBA.

The variation of L_{eqA} with time at all 25 premises is shwon in Fig. 3 and the distribution of sound levels is shown in Fig. 4.

The mean curve (b) is constructed from the means of all the stated percentile values and S.D.'s for these values range from 8.1 dBA in the case of L_{99} to 4.8 dBA for L_5. The peak channel value recorded by the analyser in the whole of the survey to date is 122 dBA and the lowest is 52 dBA, a dynamic range of 70 dBA. However the mean dynamic range in the 25 premises is 50.6 dBA with a S.D. of 6.7 dBA obtained by inspection of the individual distributions. The range between the mean L_1 and L_{99} levels is 28.1 dBA with a S.D. of 8.0 dBA.

Frequency Analysis: Results from the tape recordings obtained during the performances are not presented at this time.

Discussion

These results must be considered in the context of the overall survey, i.e. evaluating the risk of hearing damage, and clearly they will be most useful when combined with the attedance data to give noise dose. However a number of interesting facts emerge from the results when compared with the existing data, as summarised by Whittle and Robinson.

The difference between the mean maximum (reference) L_{eqA} of 100.9 dBA and the mean dose meter L_{eqA} of 94.5 dBA, of 6.4 dBA, represents not only the difference in sound levels between the maximum levels (L_{eq}) to which individual members of the public could be exposed and what they actually experience while dancing, but also the difference due to their variation in activity, i.e. dancing, sitting, drinking, out of hall, etc. Also hidden within these results are the differences between the two types of premises in which the data was obtained - i.e. youth-groups and commercial discos, but so far early trends show differences in the order of only minus 1 or 2 dBA for youth-groups relative to commercial discos. Previous results (Whittle and Robinson) from 32 live groups from measurements with sound level meters in various positions in dance halls show a mean of 104 dBA (S.D. 6.2 dBA) and from 28 recorded music measurements, 91 dBA, with a weighted mean for the two sets of data of 97.9 dBA (our value). These results are not directly comparable because of the mixed nature of the results presented here but generally show an over-estimate of approximately 3 dBA based on the mean dose meter L_{eq}'s which is what these earlier measurements are presumably intended to represent. Evidence from the spot readings by SLM show a dance floor mean of 98.7 dBA (S.D. 3.2 dBA), again showing an over-estimate of the dose meter L_{eq} by some 4 dBA. This tends to confirm what was generally suspected, that sound level measurements by SLM's on the dance floor over-estimate the L_{eq}'s experienced by attenders. Whittle and Robinson's estimate of 3 dBA in this respect appears reasonable at this point in the survey.

No previous information is available on the change of L_{eq} with time. Fig.3 shows that, on average, the L_{eqA} at the reference instrument increases by 7 dBA over the duration of the performance. The reason for this is not clear (other than the obvious one of measured output'.) but it may well be related to the increase in number of persons, and therefore a greater absorption, in the premises in an attempt to maintain the same overall sound pressure level on the dance floor, or to the requirements of the dancers who may well be experiencing some temporary threshold shift towards the end of the performance. Some evidence on this matter may be available from the variation in dose meter L_{eq}'s or modifications to the measuring procedure incorporated in the latter part of the survey. The implications of this change in L_{eqA} with time is the way in which this may influence the noise dose of attenders who stay in the premises less than the whole duration of the event.

The overall dynamic range of 70 dBA with a lower and upper level of 52dBA and 122 dBA respectively, indicates the wide range of conditions encountered in the survey. More typical of the actual conditions in the premises is the mean dynamic range of 50.6 dBA obtained from the individual distributions within the premises. However, this range covers the whole duration of the event and as the lower levels occur almost exclusively at the beginning of the performance a more realistic figure for dynamic range would be that indicated by the difference between the L_1 and L_{99} percentile values - which is 28.1 dBA. No information is offered at this time on the dynamic range of the music but this, together with information on the frequency spectrum of the music, will be available in the final report.

As stated earlier the work on this project is not completed and further work will allow greater confidence to be placed in the results and some of the hidden trends, in particular those relating to different types of premises, to be examined in detail. Additionally some information is, or will be, available from premises in other parts of the country, notably Bedford, Carlisle and Newcastle, which will allow some comparisons to be made on a nationwide basis. In this respect we would be grateful for any information which may be available elsewhere which anyone with an interest in the problem might bring to our attention, and offers of help to obtain information by making measurements would be welcomed.

Although primarily designed for hearing hazard purposes, the information may also be useful for planning and noise control purposes where premises such as youth-groups and commercial discos are, or are likely to be, operated in residential areas. The mean dose meter value of 94.5 might well be taken as indicating mean levels in the premises to which, say, two standard deviations could be added to cover 97% of the premises, giving a level of approximately 102 dBA to form the basic criteria for the design of noise control measures.

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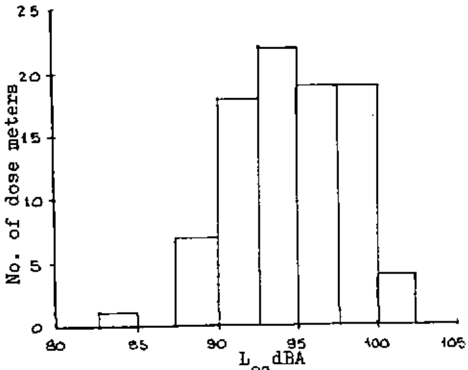

fig.1 Dose meter L_{eq}'s from 90 individuals

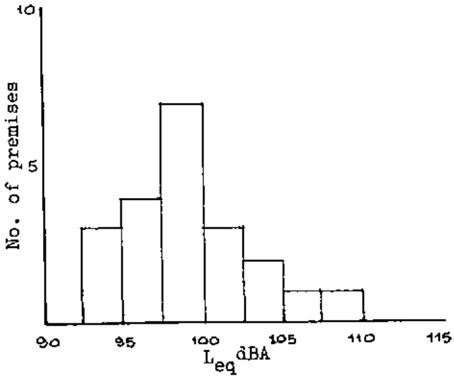

fig 2. Reference L_{eq}'s in 25 premises

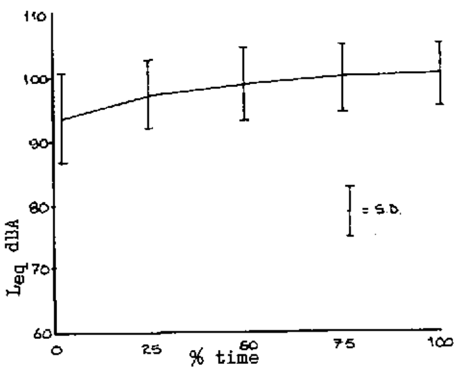

fig.3 Variation of L_{eq} with time in 25 premises

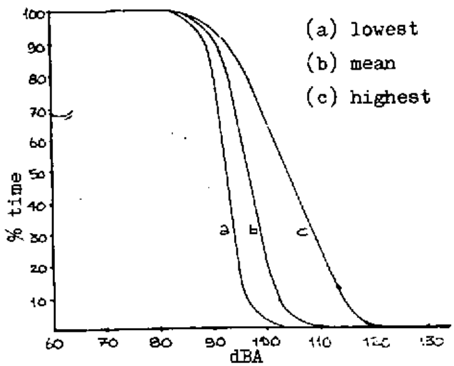

fig 4 Distribution of sound levels in 25 premises

References

Whittle, L.S. and Robinson, D.W. 'Discotheques and Pop Music as a Source of Noise Induced Hearing Loss - A Review and Bibliography'. NPL Acoustics Report Ac 66, March 1974.

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