A SURVEY OF NOISE AND HEARING PATTERNS IN AN INDUSTRY IN MYSORE CITY

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1. Statement of the Problem

'A Survey of Hearing Patterns of Industrial Workers in Mysore City'.

The problem is to find out the pattern of hearing among the industrial workers who work in different noise environment and to find the relation between these two factors.

2. Introduction

More and more concern being paid about the occurrence of unwanted sounds, commonly called noise, and their possible effects upon man. Despite frequent conferences and symposia and the existence of an extensive literature on noise the necessary information is to some extent elusive. Many problems arise from noise, viz., annoyance, interference with conversation, leisure or sleep; effects upon the efficiency of work ; and potentially harmful effects particularly on hearing; these problems may arise in a variety of situations.

The industrial applications of audiology deal with noise and its effects upon workers and their,

(a) Hearing acuity,
(b) Safety,
(c) Communication, and
(d) Performance.

The basic question which confront an audiologist include, 'What is the type of hearing loss related to a given noise environment'? or in other words, "Is there a relationship between job noise and the hearing loss" ?

Continued exposure to an intense noise causes a gradual cumulative loss of hearing. The loss is typically a high tone loss and it is usually begins at 4K Hz. Sometimes high frequency cut off is quite abrupt on the audiogram but more often it is gradual. The relations of hearing loss to noise exposure involve, frequency, sound level, temporal distribution, schedule of exposure are recovery, over all duration, etc.

Several studies have been made to associate job noise at various locales and pattern of hearing loss. However much studies in India are very few. The present study is a hearing and noise survey in an Indian industry which is situated in a

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relatively quiet non-industrialised city (Mysore). The JAWA motor-cycle factory in the Mysore city has been chosen for the present survey.

2b. Definitions

1. *Noise :* Noise is defined as any unwanted sound and that it will be measured by an SPL meter and will be expressed in terms of decibels (dB's). The noise may be intermittent or continuous.

2. *Steady Noise :* is characterised by sound pressure levels, measured in octave bands, that do not fluctuate rapidly with time. Fluctuations occurring at the rate of a few decibels per second satisfy this requirement. Rotating and reciprocating machinery usually produced steady noises.

3. *Impulse Noise:* is characterised by SPL's, as measured in octave bands, that fluctuate at a moderate rate, say greater than a few decibels per second. Steady hammering, riveting etc., typically such noise sources.

4. *Impact Noise:* is characterised by SPL's, as measured in octave bands, that fluctuate at an extremely fast rate with time. Drop forges, occasional hammering, etc., are examples of devices producing this type of noise.

5. *Exposure*: This term refers to the period of time employees are subjected to a noise.

6. *Continuous exposure* : Usually expressed in years, denotes the time spent by the workers in the course of a regular work schedule. This takes into account the fact that the worker is normally in the noise 8 hours out of 24 hours; that during this 8 hours period there are coffee breaks and lunch periods, etc. And that during a year's exposure there are vocations, sick leave, etc.

7. *Intermittent Exposure*: This refers to exposures that cannot be classed as continuous. For example, an airplane pilot flies for several hours one day and possibly does not fly at all the next day. Obviously there are many cases of exposures where the degree of intermittency is difficult to assess. The correlation of data taken under such conditions with data taken for continuous exposure or under different degrees of intermittent exposure must be carried out with judgement

3. Review of Literature

Industrial hearing loss has long been recognized under the names 'boiler makers' deafness' and 'weavers deafness'. Among early investigators were those of Crowden (1939) who used speech audiometry to investigate the hearing loss of those exposed to the noise of riveting, and Dickson, Ewing and Littler (1939) who studied by pure tone audiometry the hearing of those who exposed to aeroplane engine noise. Since the end of World War II the relation of hearing loss to noise exposure has been quite widely studied, but the data directly used for the prediction of the damaging effect of different noise,.levels, for example, are not very numerous and the complexities of the situation are such that there are yet many uncertainties. The study of effects of noise on hearing has a long history. The earliest documented evidence relates to a study in the year 1880 of the rail-road noise and its effects upon hearing (Rudmose, 1957).

Hearing loss resulting from exposure to loud noises is known as acoustic trauma, such hearing loss may be either conductive or perceptive in nature or sometimes even a combination of both. The earliesc indication of acoustic trauma is provided by an audiogram which shows a dip in the region of 4KHz known as the C5 dip. The part of the inner ear which is first affected be exposure to intense noise is the outer layer of the hair cells near the basillar end of the organ of corti. Subsequently, other areas of the organ of corti and the VIII nerve itself may become involved as the exposure continues. Tinnitus and Dysacusis can be marked. The hearing loss for individuals in diverse occupations as :

Boiler makers
Machine operators
Blacksmiths
Textile workers — shows maximum hearing
Jeg engine test bed workers — loss within 2K.HZ-6KHZ
Army gunners
Jet air craft pilots
Overhaul and repair shops
Grinding and metal polishing shops, and etc.

In present days of rapid development in industrial technology, we have continually changing noise pictures and therefore there is a greater attention being paid to this.

Since a long time a number of associations, universities, health onganizatlons and industrial settings are doing noise study and hearing conservation programmes in U.S A. and in many other industrially advanced countries. Various workers have studied the effects of noise on hearing. (Hallowell Davis, S. Stevens, G. Von Bekesy, D. E. Broadbent, R. R. A. Coles, Copeland, M.E. Delany, Hinchcliffe, J. J. Knight, A. E. Knowler, K. D. Kryter, T. S. Littler, Ramsey, D. W. Robinson, W. Rudmose, R. W. B. Stephens, W. Taylor, J. C. Webster, L. Beranek, I. J. Hirsh, William Burns and etc.

Recently few institutions, universities, health organizations, and industries are taking up these kinds of studies in India. In the following lines, some of the Indian contributions pertinent to this field has been mentioned.

H. C Gangoli and M. S. Prakash Rao (1954) have done a hearing and noise survey in a Calcutta Jute Factory and found :

1. Effects of noise reduction on efficiency vary from worker to worker.

2. The younger workers, in contrast to the older workers are likely to have significant differences in out-put, gain or loss, following a reduction in noise.

3. Regular periodic interviews with the subjects showed that the reduced noise condition was found to be less annoying and more comfortable to the workers.

4. For a large group of men working in a noisy environment like the weaving shed, reduction of noise by the use of ear defenders is not likely to increase their productive efficiency substantially.

The management of laboratory studies is easier than of industrial studies, because of the fact that environmental and work conditions can be more easily controlled. It is for this reason, that laboratory studies on effects of noise, far out-mumber field studies.

Adiseshaiah et al (1959) have done some laboratory studies on noise and its effects on several physiological processes, the results are as given below:

Topic	*Experimental Condition*	*Results*
I. Noise and Sensori-motor performance	Simple reaction time-subjects exposed to white noise of—90-95 dB	Slight increase in R.T. observed. Variability in performance increased under noise condition.
II. Noise and performance involving higher mental process	Comprehension and recall of written material. White noise of 90-95 dB	Performance slightly affected adversely.
III . Noise and performance in vigilance tasks	Watching for signals in a paper pencil vigilance task—noise 90-95 dB	Out-put did not fall. Percentage of omission increased.

H. C Ganguli, 1951, and H. C. Ganguli and M. S. Prakash Rao (1954) has studied the effects of air craft noise upon human hearing and concluded as follows :

(a) The air craft maintenance men on the whole undergo hearing loss greater in extent than those persons who work in a different trade. Although some of them do retain normal auditory acuity, the average maintenance men show some loss which is attributable to the air craft noise. A certain percentage of workers have intense subjective dislike for these noises which is aggravated by the anxiety that they may go deaf.

(b) The over-riding feature of,psychological as well as physiological reactions to noise is the problem of different individual susceptibility to noise effects, and

(c) There is a great similarity between air craft maintenance workers and the workers in conventional industries like the textile industry.

In addition to above studies, the I.C.M.R. (Indian Council of Medical Research) has taken up a nation-wide study on noise and their effects on hearing at various centres in India.

4 (a) Selection of Subjects

As the management of the factory permitted to take only a limited number of subjects for the survey, it is not possible to test all the workers in the factory. As far as the selection of the subjects, following criteria is used :

Wherever the N is 30—and below—all the workers in that section are taken for the testing.

Where N is above 30—then a minimum of 30 workers or 25% of the total number of the workers in that section or whichever is more are taken for the survey.

The details of the number of the workers taken for the survey are as shown in the Table 1.

Table 1

Sl. No	Name of the section	Total No. of workers in the section	No. of workers taken for the survey
		'X'	'Y'
1.	Assembly (Engine)	30	30
2.	Assembly (General)	80	30
3.	Chamber section	50	30
4.	Degreasing	10	10
		2	2
5.	Dicasting	32	30
6.	Electro-plating	28	28
7.	Heat-treatment	30	30
8.	Machine shop	216	54
9.	Paint shop	26	26
10.	Press shop	49	30
11.	Polishing shop	22	20
12.	Press welding	34	30
13.	Testing and general repair	10	10
14.	Tool Room	34	30
15.	Welding (general)	65	30
	Fifteen sections	716	420

'X' is the total No. of workers in a particular section, includes the No. of workers who work in the first and general shift.

1st shift: 6.00 a.m. to 2.30 p.m. (Break—10.00 a.m. to 10.30 a.m.)
General shift: 7.45 a.m. to 5.00 p.m. (Break—12.15 to 1.05 p.m.)

4. (b) Instrumentation

For the present survey mainly two instruments are necessary, they are :

1. Sound Level Meter with the Octave Band Analyzer.
2. A portable Audiometer.

1. *Sound Level Meter (S.L.M.)* type 2203 is used in this study. It is an instrument which essentially consists of a high quality condensor microphone, a variable gain and a meter calibrated to indicate the sound pressure levels in decibels. This sound level meter is provided with three frequency weighing net works (A, B & C).

A and B net works provide a progressively increasing attenuation for frequencies below 1000 Hz and are used for measuring the sound levels around 40 and 70 decibels.

Whereas the C network provides a practically flat response to all frequencies aad is used for measuring sound levels of 90 decibels and above.

Here, in the study the C scale is used for measuring the sound levels in the factory.

2. *Audiometer* : A portable type, battery operated (9 volts), Madsen Audiometer is used for the threshold measurement of hearing and this audiometer has been calibrated to the International Organization of Standards (I.S.O. Standards).

4. (c) Test Environment and Method of Testing

1. *Room for Audiometric Testing* : The hearing test is being conducted in one of the rooms, which is attached to the main factory building. This is the only room available adjoining to the office having the minimum noise level—A scale 50 db; B scale 60 db and C scale 70 db. After closing the ventilators and the windows of the above room with the layers of glass-wool, thermacol and the acoustic tiles, the level of the ambient noise in the room has come down to the following noise levels as shown in Table 2.

Table 2. *Indicating the acoustic condition of the testing room*

Sl. No.	Acoustic conditions	Sound Pressure Levels in dB's Scales A	B	C
1.	Pre-acoustic condition	50	60	70
2.	Post-acoustic condition	44	50	60

In an ideal sound treated room for the purpose of hearing testing, the level of the ambient noise permissible in that room should be less than 50 dB in C scale. But the room chosen in this survey is having the noise level more than the permissible level. Hence the amount of threshold shift occurring in this room due to the excess of noise has been found out and the amount of shift forms the correction factor for the audiograms taken in this room. The procedure used to find the threshold shift is as follows: "A group of 10 subjects with normal hearing were tested in one of the sound treated rooms in The All India Institute of Speech and Hearing, Mysore with the same audiometer they were again tested at the room in the factory in order to see the shift in the threshold. It was observed that there was shift in the original threshold, the shifts are as shown in Table 3.

Table 3.

Ear	250	500m	1K.HZ	2K.Hz	4K. Hz	6K.Hz	8K.Hz
R.E.	*10 db*	*10 db*	3 db	0.8 db	-2.5 db	—0.8 db	0.0 db
L.E.	*14 db*	*10 db*	2.5 db	1.6 d b	—0.8 db	—4.0 db	1.5 db
C.BC	15 db	12.5 db	6.5 db	2.5 db	2.5 db		

Note: Where the shift is above 5dB, it is significant because in conventional audiometry, we give provision of ± 5 dB as test retest reliability.

Apart from the table of threshold shift, a table showing the average thresholds of normal subjects at the room taken in the factory is given below :

Table 4.

Ear	250	50U	lK.Hz	2K.Hz	4K.Hz	6K.Hz	8K.Hz
R.E.	*15 db*	*15 db*	5 dB	Odb	5 db	5 db	10 db
L.E.	*15 db*	*15 db*	5db	5 db	5db	5 db	15 db
CBC	15 db	lOdb	5 db	5 db			

(a) *Size of the room* : Length 25 ft. ; Breadth 15 it. and Height 12 ft.

it is a rectangular room with three windows facing the open field, but not to any traffic area. There are three windows whose size is 4 ft. x 4 ft. whiea iias been closed by thick curtains. Similarly there are three ventilators whose size is 6 ft. X 2 ft. which has been closed by layers of glass wool, thermacol and the acoustic tiles.

(b) *Testing area:* In that room one corner is selected for hearing testing, whose area is 5 ft. X 5 ft. and this area has been covered by a three inch gunny bed and two thick carpets in order to damp the ground vibration.

Method of Testing

Response criteria: The threshold for hearing has been defined as that value of the stimulus which evokes a positive response in 50% of the trials.

Each worker has been tested for the following tones at fixed intensity levels as mentioned in the Table 5. Those who do not respond at these present levels, they are considered to have failed the screening test. For those who have failed on the screening test, a detailed audiometric test will be done in the same room.

Table 5.

E.N.T. Testing Frequencies	250	500	IK.Hz	2K. Hz	4K Hz	6K.Hz	8K.Hz
A.C. Rt or Lt	20 db	25 db	15 db	15 db	15 db	15 db	15db
Common B.C.	15 db	15 db	5db	5db	5 db		

This being done in the section itself by an E.N.T. specialist in the factory before hearing testing.

Noise level

The noise levels in each section in the faetory has been found out by using the Sound level meter type 2203 and the data for the same has been given in the Table 6.

Table 6. *The approximate sound pressure levels measured by the SLM type 2203 are as follows.*

Sl. No.	Name of the section	Sound Pressure Levels in dB's Scales A	B	C
1.	Assembly (Gen.)	75	70	81
2.	Assembly (Engine)	70	72	74
3.	Degreasing	78	80	82
4.	Dicasting	80	82	82
5.	Electro-plating	78	84	88
6.	Testing (a)	84-98	84-102	85-104
	(b)	88-100	90-102	95-105
7.	Gen. Repair	80	85	87
8.	Heat treatment	80-84	80-88	86-90
9.	Machine shop	84-87	86-92	88-92
10.	Paint shop	85	86	92
11.	Polishing shop	84	88	82
12.	Press shop	82-95	84-96	87-98
13.	Welding (Main)	85-90	86-94	88-94
14.	Press welding (a)	84-90	85-93	86-93
	(b)	92-106	94-107	94-108
15.	Tool room	79-82	82-95	85-88

5. Anticipated Results

The workers of the following sections are expected to show loss at 4K-Hz and at 6K.Hz.

1. Testing and general repair
2. Heat treatment
3. Machine shop
4. Paint shop

Workers in sections press shop and press welding which are having maximum noise levels are expected to show more hearing loss at 4 Hz.

6. (a) Clinical Implications of the study

1. The results of the present survey will be an additional information to the existing literature about industrial noise hazards and its effects upon hearing.

2. The results of the present survey helps us to make constructive suggestions for hearing conservation in an industrial setting

6. (b) Limitations of the study

1. It is not possible to test all the workers in the factory.

2. The room chosen for audiometry can't be matched with an ideal sound treated room.

3. The workers taken for the survey do not have pre-placement audiograms.

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