DEVELOPING A CASE HISTORY FORM TO DETECT NOISE INDUCED HEARING LOSS CASES

Register NO.M8922

AN INDEPENDENT PROJECT WORK SUBMITTED IN PART FULFILMENT FOR FIRST YEAR M.Sc, (SPEECH AND HERRING) TO THE UNIVERSITY OF MYSORE

ALL INDIA INSTITUTE OF SPEECH AND HEARING: MYSORE - 570 006

MAY 1990

TO MY

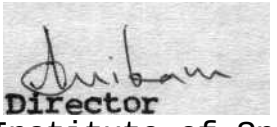
PARENTS, BROTHERS, SISTERS

AND

FRIENDS

C E R T I F I C A T E

This is to certify that the Independent Project entitled 'DEVELOPING A CASE HISTORY FORM TO DETECT NOISE INDUCED HEARING LOSS CASES' is the Bonafide work in partial fulfilment for First Year M.Sc (Speech and Hearing) of the Student with Register No+8922.



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C E R T I F I C A T E

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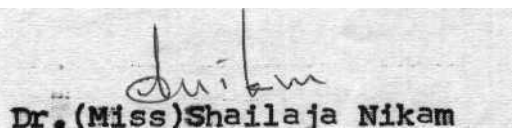

Guide

D E C L A R A T I O N

This Independent Project entitled 'DEVELOPING A CASE HISTORY FORM TO DETECT NOISE INDUCED HEARING LOSS CASES' is the result of my own study, undertaken under the guidence of Dr.(Miss)Shailaja Nikam, Professor and Head of the Department of Audiology, All India Institute of Speech and Hearing, and has not been submitted earlier at any University for any other Deploma or Degree.

Reg.No .M8922

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INTRODUCTION

Noise has been often described as undesired sound by the recipient. This definition however is valid only when it specifies the sound to be harmful or one that interferes with normal activities, especially communication and efficiency. Noise has been a part of human civilization added to it technology among the numerous environmental pollutants it has created, noise has also come to be a major and an immediate and identifiable pollutant.

Many industrial process since the industrial revolution have generated noise of sufficient sound level to cause deafness. It is only in recent years, however that the consciousness of man has been alerted to the physical hazards of noise pollution, especially as it effects the auditory system. It is scientifically correct to state that continuous exposure to the high level noise can cause sufficient damage to the auditory system to produce a hearing impairment thatis permanent and irreversible. Such hearing disorders can affect one's ability to communicate meaningfully and effectively. The seriousness of this type of auditory disorder is its imperceptible nature. The main problem is that the frequencies outside the critical speech band are the ones initially affected due to which the individual may be unaware of the hearing disorder for a "dangerously long time" before awareness. Hence by

the time he becomes aware it is often when it disturbes his normal functioning which in turn is only after the loss has extended in to the critical communication band. To compound this problem there is no standard measure which will accurately identify those who may be regarded as high risk individuals.

The dire need to work and make amends in the fields of noise exposure consequently hearing conservation with timely identification and effective management is well evident from the hazardous effects of noise and on not only the auditory system but also physical health psychological stability.

Hence among the various steps to be taken, identification of the noise affected individuals becomes primary and initial, an effective and successful identification is ensured only when all the relevant information is available. This in turn implies the major role the case history plays in this process case history has helped in giving a lead towards any identification or diagnosis of a disorder. It has been a stepping stone in the awareness, identification, diagnosis and management of any disorder. So it is in the case of noise induced hearing loss (NIHL).

Literature and research are perennially in the process of modifying and improving the attempts made to draw comprehension or effective guidelines in the case history or survey

of NIHL. Thus, here is an attempt to built a frame work of the case history in NIHL - survey which has been tested on industrial population.

I. Noise in industry:

The problem of industrial seems to be as old as industry itself. Ramazzini (1913) who has been called the "Father of occupational medicine" noted that deafness was an occupational disease of millers to coppersmiths. Like-wise several investigators Fosbroke (1830-1831). Barr (1986), Anonymous (1908), Walber Greenwood (1933), Hammerton (1935), Lempert and Bryan (1981), Passchier-Vermeer (1968), Burns and Robinson (1970) have reported in their studies that deafness amongst professionals liKe ship's carpenters, frizzars to boiler maKars etc.

(a) Incidence of industrial noise: Noise is almost certainly the most widespread in the modern industrial environment. A most comprehensive study was done by U.K. factory inspectorate. Anonymous (1974) in which 6.4 million workers were covered out of which 590,000 were exposed to noise of 90 dB or more for 6 hours per day and that a further 570,000 were exposed atleast some of the time.

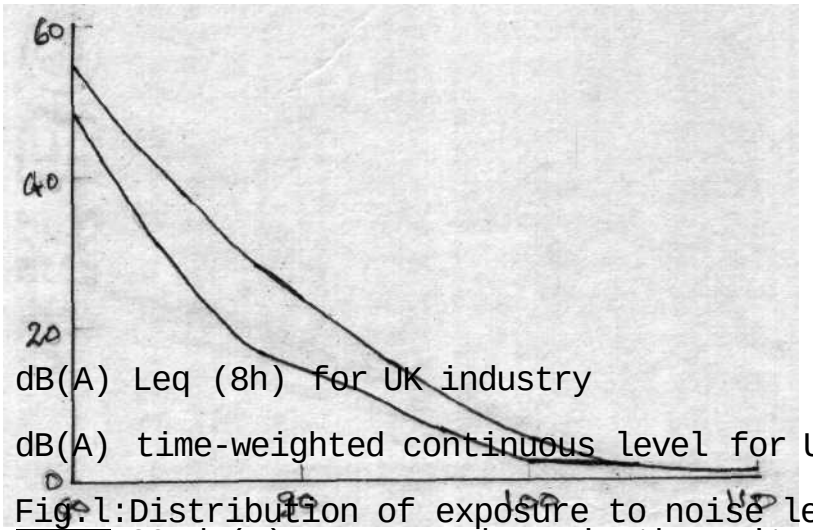

Fig.1: Distribution of exposure to noise levels in excess of 80 dB(A) among workers in the United Kingdom and the United States (Data from Health and Safety Executive 1982).

(b) Hearing conservation programmes: The conservation of hearing by means of control of the noise level at the workers ear is complex requiring the cooperation of engineers, medical staff, management staff, work force, etc. In brief essence of hearing conservation programme is given in the following table.

Table-1: Essentials of Hearing Conservation Programmes.

Operation		Function
Noise survey	:	Identification of hazardous areas/occupations.
Noise control	:	Reduction of noise at source Enclosure of noise source/operator to reduce noise to safe levels. Use of sound absorbers.

1.		2.
Hearing protection	:	Where noise control is not possible, provision, fitting and maintenance of ear plugs/muffs for personnel at risk, together with their education in the hazards of noise.
Industrial audiometry	:	Monitoring of the effectiveness of hearing protection. Pre-employment and serial audiometry to identify noise-sensitive workers.
Organization of hearing conservation programmes	:	Co-ordination of work of medical, safety and occupational hygiene staff involved. Education of management and workforce. Referral and redeployment of workers with hearing loss/damage.
Legal aspects	:	Statute and common law, legal liability, likely legislation.

II. Noise control:

Noise control is the first and most fundamental step in hearing conservation programme. Basic approach is to reduce the noise at its source by containment, sound absorption and isolation. If this is not possible then noise is controlled the path that noise takes. Even if this is also not possible it is controlled at reception by ear muffs, ear plugs, etc.

III. Noise and Hearing:

a) Hearing Loss due to steady-state noise: Damage due to the steady-state noise is confirmed to the inner ear in which there is a selective distraction of hair cells. Robinson (1971) reported that long-term exposure to steady-state noise causes a permanent loss of hearing.

b) **Hearing loss due to impulsive and impact noise:** Impulsive noise is defined as the short duration sound characterized by shock front pressure wave form. Damage risk criteria for an impulsive noise according to CHABA (1968), permits 100 exposures per day to a peak pressure of 160 dB with the total duration of 10 m.sec. raising to upper limit of 174 dB per exposure per day not more than 25 m.sec. This criteria is based on temporary threshold shift (TTS) of 10 dB at 1000 Hz, 15 dB at 2000 Hz and 20 dB 3000 Hz.

c) **Presbycusis:** It is deterioration in clinically normal ears which takes place with advancing years in the absence of any injury/disease. Hinchcliffe (1955) measured thresholds from 120 Hz to 12 KHz as a sample of 400 subjects taken from rural areas. He found an increase in thresholds between 2 KHz to 8 KHz and males are consistently inferior to females.

d) **NIHL and presbycusis:** Both are basically similar affecting inner ear initially affect hearing at higher frequencies and develop slowly, but however, both differ in that NIHL shows a maximum at 4 KHz whereas presbycusis shows continuous increase towards higher frequency tested. Presents of presbycusis could influence the NIHL.

One can speculate that the existence of presbycusis could influence noise induced hearing loss in three different ways:

1. The affects of noise and age are independent and can be added.
2. Loss of this nature (either noise or age induced) reduces the sensitivity of the ear to noise and hence to damage and provided a protection against further loss.
3. An ear damaged by age or noise is less robust than normal and is therefore particularly vulnerable to further damage.

e). Individual susceptibility to noise damage: All the individuals who are subjected to noise exposure may not have similar effect on hearing. This is because of the individual differences in susceptability. Some have more resistance to noise damage and some have the least.

f) Temporary threshold shift: This is a short time elevation of hearing thresholds after an exposure to high level noise. It is often noticed by visitors to a noisy Industrial environment, who after a period in noisy work place may find their cars and sorrounding environment, unusually/quiet. The extent to which hearing threshold is raised depends on intensity and duration of noise exposure and is maximum just after termination. Ward, et al. (1958) reported that the recovery of temporary threshold shift log to recovery time. The frequency of maximum threshold shift is related to frequency of noise stimulus and for high level of noise it is about half an octave above the stimulus.

IV. Noise and Health:

From physiological point of view non-auditory effects occur in 3 stages:

1. Rapid tensing of muscles at the sudden onset of noise. This is mediated by motor nerves.
2. Tensing is followed by slightly slower effects mediated by autonomic nervous system, heart rate changes, respiratory volume etc.
3. There are effects mediated by hormonal activity controlled by pituitary adrenal glands including both parts of these two glands: Neuro and adenohypophyseal parts of pituitary and adrenal cortex and medulla. The action of these glands are largely controlled by the hypothelamus.

a) Noise and sleep: Short term physiological effect may be divided into two categories: The startle effect due to its sudden onset and overall sustained effect of prolonged noise. SOKOLOVE described orienting responses to sudden onset and defence responses with sustained or repetitive stimuli of high intensity sound.

b) Cardiovascular effects: Noise in the cardiovascular system produces vaso-constriction especially small blood vessels in limbs, skin etc. which results in reduced blood volume and blood flow in these parts of blood. At the same time with moderate level of acoustical stimulus vasodilation resulting in increase of blood flow in head.

c) **Effects on digestive system:** The gastrointestinal motility increases with an increase in noise level and decreases with decrease noise level. The long term effects of noise gastrointestinal tract studies have shown high incidence of gastrointestinal disorders (56% of subject) on X-ray examination on workers expose to high level of occupational noise over a period of 15 years of more.

d) **Effects on respiratory system:** Noise has little effect on the respiratory system, studies have shown that noise induced slow deep breathing, which ensures hyper ventilation of lungs. Increase in depth of ventilation to noise of high levels (above 120 dB) is dangerous.

e) **Effects on central nervous system:** Effects of noise can be subdivided into psychological and neurological effects. In a study on psychopathological effects of noise exposure found that mental hospital admission is significantly higher among people living in noisy area. Mild neurotic depression reaction is also found. Neurologically it was found that few patients had epileptic fits in acoustical stimulation.

f) **Effects on special senses:** Apart from effects on the function of the inner ear noise has effects on vision and balance.

Although in normal individual high acoustic stimulation evoked responses like dizzy and nystagmus at level above 130 dB but with patients of vestibular labyrinth disorders show similar responses at 90 to 100 dB.

In the case of vision the effects are temporary in nature. It is documented that visual field is narrowed to due to high level noise exposure. Studies are shown that noise stimulation induce dilation of pupil, dilation increases with the intensity of stimulus.

g) Effects on endocrine system: Endocrine gland adrenal modula produces adrenaline and non-adrenaline, the blood levels of these two increases with acoustical stimulus. Similarly, the level of ACTH also increases by noise exposure.

h) Effects on reproductive system: The effect of noise on human beings were not studied in this aspect. In animals like rats, cats, etc. indicated low birth weight, developmental abnormalities, bone deformities in the fetuses of animals exposed to high levels of noise.

i) Effects of skin and musculo-skeletal system: The changes in skin consists of fall in blood flow caused by vaso constrlctive effects of noise coupled with transitory galvenic skin response.

Electromyographic studies on musculoskeletal system indicated a brief change skeletal muscular tension on the onset change of noise.

j) Effects of noise on general health: Studies on human working in noise investigation have suggested increase incidence of heart disease problems with peripheral circulation, vestibular problems and accidence at work. If there is a pre-existing disorder, increased sensitivity and deterioration of their condition due to noise results.

V. Noise and communication:

A communication system consists of three parts: a transmitter; a channel; and a receiver. In speech communication the transmitter is the talker's vocal apparatus controlled by his musculature and brain, the channel is the air in which he lives and the receiver is the auditory system and brain of the listener. The speech signal is usually contaminated by the noise. As a result of unwanted sound source especially this is true in industrial set up.

a) Speech intelligibility in Noise: The standard method of assessing a speech communication system is to have a talker read a list of words or sentences and a group of listeners write down what they hear. The responses are scored by calculating the percentage of words correctly heard. The figure-2 obtained is known as the articulation score.

intelligibility, of system. It is seen that intensity of 35 dB is necessary for 50% of syllables to be heard correctly. The maximum intelligibility is achieved at the level of 80 dP, and above this level intelligibility begin to fall. Miller and Licklider,(1950) measured word articulation score for speech by varying signal to noise ratio and frequency. They found that for signal to noise ratio of minus 18 dB at low frequencies the noise was half of the word, so the score is approximately 50%. At noise interruption frequencies greater than 100 Hz the noise masks the speech completely, resultant articulation score was around 5 to 10%. The articulation scores raises with the maximum at 10 Hz. at signal to noise ratio of plus 9 dB. The interrupting noise has little effect on intelligibility of speech.

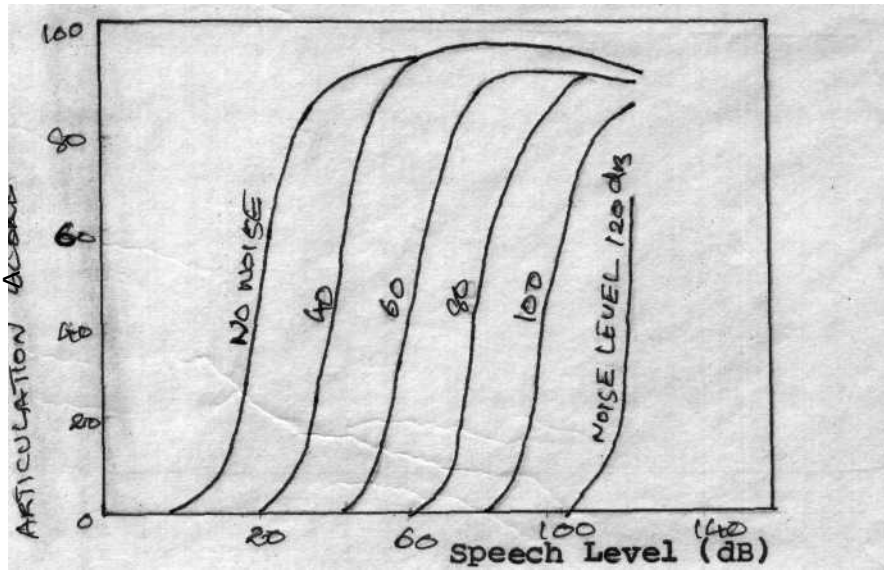

Fig.2; Articulation score as a function of intensity for CVC syllables with no noise and with added random noise.

VI. Noise and efficiency:

Several studies have been done the effects of noise on human efficiency. Kriyter (1970) reported that noise will not harm the organism or interfere with mental or motor performance. To summarise the effect of noise and efficiency -

a) Noise may improve or impair efficiency, bat in either case the effects are more likely to occur later in the work session than immediately.

b} Adverse effects normally occur with complex, multi-component tasks or those in which the information load is high.

cl Improvement can occur in simple routine operations normally associated with boredom and loss of attention.

di Effects of steady broad band noise are rare with sound pressure level (SPL) of less than 90 dB, though changes in other noise parameters can affect performance at lower level.

METHODOLOGY

The questionnaire which includes 33 questions were prepared to obtain the information from industrial workers in Mysore. The intention of sending this quesionnaire was to get information whether the subjects were really exposed to loud noise and if that noise level hazardous to the workers, that is whether workers are in danger of getting noise induced hearing loss (NIHL).

Preparation of questionnaire:

The questionnaire (Appendix A) was prepared to cover the following areas:

a) **General information:** This include demographic information of the worker such as age, sex, address, education and particular of the industry where is employed.

b) **Technical information**: Type of noise that the worker is exposed to while at work industry, level of the noise and duration of exposure to noise were included. Also general questions regarding complaint of increase in blood pressure were included.

c) **Ear aad hearing:** Here the questions were asked regarding ear i.e. complaints of ear ache etc. and hearing i.e.

complaints of fluctuation in hearing level or complaint of hearing loss after exposure to noise. Questions were also asked about fatigue etc.

d) **Speech and voice**: Questions pertaining to the involvement of treatment frequent shouting due to noise and/or complaint of change in voice due to involvement of frequent shouting because of noise were included.

The draft questionnaire was given to a few professional trainees who were aware of noise and effect of noise to verify clarity of the questionnaire and also was given to few laymen to ensure comprehension. A few questions were modified according to comments received.

ANALYSIS OF RESULTS

The results of the responses received on questionnaire developed are presented in this chapter.

Of the 50 questionnaires (25 for professional trainees and 25 lay people) distributed all the 50 are given the response i.e. 100%.

Age: Data revealed that higher percentage of professionals were in the age group between 20 to 25 years.

Distribution showing professionals by age and sex.

Table-1: Showing the number of professionals evaluating the questionnaire.

Age group	No.	Percentage	Male	Percentage	Female	Percentage
15 - 19	6	24	3	12	3	12
20 - 24	17	68	9	36	8	32
25 - 29	2	8	2	8	0	0
Total	25	100	14	56	11	44

Distribution of lay people by : Age and Sex.

Table-2: Showing the number of lay people evaluating the questionnaire.

Age group	No.	Percentage	Male	Percentage	Female	Percentage
20 - 24	11	44	7	28	4	16
25 - 29	5	20	2	8	3	12
32 - 34	6	24	4	16	2	8
35 - 39	3	12	3	12	0	0
Total	25	100	16	64	9	36

Subjects: The subjects who took part in this study could be grouped as follows: Lay people and trainees in a professional training programme. The characteristics of these groups are given below:

1. **Lay people**: The questionnaire was distributed randomly to people who came to AIISH for evaluation and for therapy.

The subjects of this category were grouped into three classes i.e.

- Those whose maximum educational experience was upto 4th/5th class.
- Those who studied upto S.S.L.C. or P.U.C. and were employed in semi-skilled jobs.
- Those who completed P.U.C. and also had additional formal training course or doing their degree with no knowledge about noise and/or about noise effect.

Occupation: As the questionnaire were distributed randomly the data revealed that people in both skilled and unskilled such as

conductors, cooks, teachers, house-wifes, coolies were represented.

2. **Professional trainees:** About 9 and 16 persons possessed B.sc., and M.Sc., degree in Speech and Hearing respectively were selected as a professional trainees among those professional trainees two of them were working as an audiologist and joined as a M.Sc., student..

In general, among the professional trainees in the field of speech and hearing i.e. 25 subjects 14 males and 11 females ranging in age from 15 years to 29 years 100% have been reported that all 33 questions could be well understood. Among lay people 28% found difficult in interpreting question No.29 (Appendix-A). 100% of the sample have understood well other 32 questions.

Procedure: 25 subjects were taken randomly for each group lay people and professional trainees. In the latter group 14 were males and 11 were females ranging in age from 15 years to 29 years. In the former male member were 16 and females were 9 age ranging from 20 years to 39 years. The questionnaire was given to all of them questions were read out for those who could follow English and asked them to label the questionnaire according to difficulty and responses were recorded.

DISCUSSION

The printed questionnaire was given to professional trainees to verify the comprehension as well as to check whether the questionnaire covered all areas of noise effects. According to those professional trainees these questionnaire were easy to comprehend and also they reported that it covered all areas which should be covered when we talk about noise effect.

The second part of this study was to give the questionnaire to lay people to check clarity or ambiguity of the questionnaire. According to ley people the report to whom the questionnaire was given or read out it was easy to understand questions i.e. what they actually meant for i.e. people were able to answer without any doubt.

In the third part of the study was made an attempt to do, but it was not possible to carry out due to some problems. However, this part of the study may be possible tocarry out if we implement noise conservation programme in industry.

SUMMARY AND CONCLUSION

A questionnaire was prepared to be used to survey the workers exposed to noise in hearing on the industrial workers. The questionnaire was prepared by gathering information from few people with consideration of information about general information a hearing, speech and voice. Printed questionnaires were given to 25 professionals trainees and 25 lay people to evaluate the questions i.e. the comprehensiveness of the area covered, non-ambiguity of the questions etc.

Analysis revealed that the professional trainees were able to comprehend the questionnaire and they reported that the questions covered the area adequately i.e. the information sought regarding noise and/its effects could be elicited through the questionnaire. In non-professional group 28% people found difficulty in understanding a few questions. These questions have been suitably modified.

The following conclusions are warranted:

1. The questionnaire is found to be effective in gaining information regarding the awareness of noise and its effect.
2. The questionnaire can be successfully used in the hearing conservation programme.
3. The questionnaire is also adequate to detect an individual's amount of exposure to noise.

4. The questionnaire has taken to consideration the workers and lay people point of view. But a study to know the requirements by employees are also to be conducted.

An attempt is also made to get first hand information from the industrial workers via questionnaire (Appendix A). However, it could not be carriedout due to unavoidable circumstances within the industries. So this part of study may be possible to do when we do noise conservation programme as a whole.

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APPENDIX-A

QUESTIONNAIRE

Names Age: Sex: F/M

Address: Occupation:

' Education:

1. Name of year Industry.

2. Type of products manufactured.

3. Do you feel the place where you work is too noisy? Yes/No.

4. Do you have to raise your voice when you talk to the person next to you? Yes/No

5. Do you use more gestures (signs) instead of talking in order to be understood? Yes/Mo

6. Do you find difficult in. understanding others' speech at the distance of 3 feets, because of noise? Yes/No

7. Do you feel that you can hear only the machine sound or noise when it is on? Yes/No

3. Do you understand better when a person is using gestures (sign) also while talking to you? Yes/No

9. Do you have to raise your voice, others to hear better? Yes/No

10. Do others have to raise their voice so that you can hear better? Yes/No

11. Do you find difficulty in understanding even when pthers shout because the noise is very loud. Yes/No

12. Do you fade above problem through oot the day or only for a few hours?

13. Were you working in noisy environment before you joined here? . Yes/No

14. If yes, specify the number of hours that you were exposed to noise in a day.

15. Specify the number of hours that you are exposed to this environment in a day.

16. Is noise present in only your section or entire factory? (strike-out which is not applicable).

17. Do you feel any fluctuation in your hearing capacity i.e. difficulty in hearing sounds clearly immediately after coming out from work? Yes/No

13. Do you find difficulty in Understanding speech when noise is.present? Yes/No

19* Bo you feel that you can understand speech better when the surrounding is quite? Yes/No

20. Do you feel that your hearing becomes better when you are away from work for a few days.or weeks? Yes/Mo

21. Do you get tired of work easily? Yes/No

22. If yes, what is the reason.

23. Do you hear ringing sound in the ear? Yes/No

24* Do you-get ear-ache when you are working? Yes/No

25. Do you find aay change in your voice? i.e. Does your voice becoming hoarse? Yes/No

26. If yes since when?

27. Did you have your hearing tested before? Yes/No

23. If yes::

When?

Where?

What was the findings?

Treatment, if any

29. Do you hate any report of increase in blood pressure when you are expose to noise Yes/No

30. Are you using any ear protective devices? Yes/No,

31. If yes, states

    The type of ear protective devices

    If it is given by your management

    If it is your own'

32. What type of noise is made by the operation of machine? (strikout which are not applicable).

    Continuous noise (eg. noise made by Refrigerator}

    intermittent noise (eg. noise made- by time-piece)

    Impact noise.

33. Any other problems you think that you face on account of working in noisy environment.