INDUSTRIAL NOISE AND ITS CONSEQUENCES—EMPLOYERS AWARENESS

Reg.No.M8910

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

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

1990

TO

Dad mum

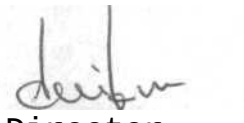
Pets

&

Wham

CERTIFICATE

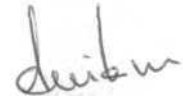
This is to certify that the Independent Project entitled: Industrial Noise and its Consequences - Employers Awareness" is the bonafide work, done in part fulfilment for First year M.sc., (Speech and Hearing) of the student with Register No.M8910.



Director
All India Institute
of Speech & Hearing
Mysore.

CERTIFICATE

This is to certify that the Independent Project entitled: Industrial Noise and Its Consequences - Employers Awareness : has been prepared under my supervision and guidance.



GUIDE

DECLARATION

This Independent Project entitled: Industrial Noise and Its Consequences - Employers Awareness is the result of my own study undertaken under the guidance of Dr.(Miss) S.Nikam, Professor and Head, Department of Audiology, All India Institute of Speech and Hearing, Mysore and has not been submitted earlier at any University for any other Diploma or Degree.

Mysore

May, 1990 Register No.M8910

ACKNOWLEDGEMENTS

My heart-felt thanks are due to:

- Dr.(Miss) S.Nikam, Prof, and Head, Department of Audiology, for helping and guiding me,right from the time of conception of the idea for this project to its completion.
- The Director, AIISH, Mysore, for extending the facilities to carry out this study.
- All my respondents, the industrialists who co-operated and sent back my questionnaires duly filled.
- The Library staff for helping me locate all my references and helping me complete my project.
- Jyoti, Vidya, and Yamini - for all the help they have given me.
- All my other friends who have helped me in all the ways possible to complete the project.
- My family members especially my dad - who's my source of confidence and my mom for all the moral support given.
- Rajalakshmi akka for having sat so patiently, to type out this project neatly.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

INTRODUCTION

"Noise is theworlds oldest pollutant. It is a non ionizing form of radiation. It is non persistent and non toxic except to the hair cells of the inner ear and nerve cells of millions of people in the world".

- Lang. W., (Inter-Noise,1988).

Noise has been described as a sound undesired by the recepient. This definition is valid but needs to be extended to sounds which are harmful or which interfere with normal activities particularly with communication and work efficiency (Tempest, 1985).

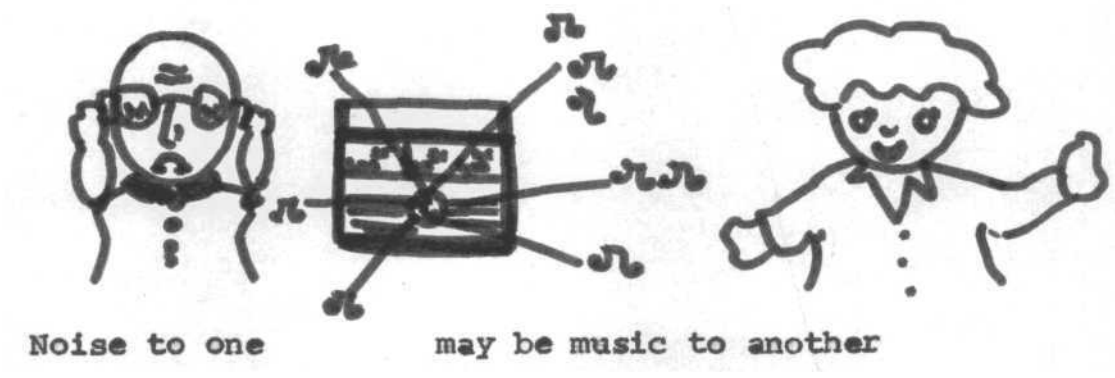
A simple definition of noise is that it is an unwanted sound but the term "noise" has different meanings for different specialists engaged in the field.

To the physicist "Noise" is sound whose character can be defined and whose properties can be measured with the same equipment that measures other sounds.

To the psychologist who is also interested in all the sounds "Noise" is an undesired sound as compared to music and speech which are usually desired sounds.

Sound is defined by the United States of America Standards Institute as an oscillation in pressure,

stress, particle displacement, particle velocity etc. in a medium with internal forces eg: elasticity, viscosity or the super position of such propogated oscillations or as an auditory sensation evoked by the oscillation described. Noise is defined by the United States of America Standards Institute as any undesired sound. It could be a pure tone, a combination of pure tones or a broad band of sound that is undesired at a particular location at a particular time.



Industry has been defined by the Websters universal dictionary as:-

a) Human exertion devoted to the creation of wealth or capital and
b) Specific labour devoted to manufacture as opposed to trade and commerce

So an industry is one which by manual or mechanical labour produces goods, articles and wares on a large scale as a commercial undertaking with highly organized division of labour.

The Longmans dictionary of contemporary English defines industry as: Factories and large organisations involved in a particular sort of work, usually employing lots of people and using machinery and/or modern methods; where factory is defined as a building or group of buildings where goods are made especially in great quantities by machines.

Noise has often been referred to as an unwanted by-product of urbanization and industrialization and as such noise is a pervasive aspect of many modern communities and work environments.

It took almost 50 years of exposure to noise in industry, before it was recognized as a hazard. It was known that noise produced hearing loss but no attempts were made to control it. The total scope of the potential problem of noise exposure to the hearing of man was not fully appreciated until recently. In realization of the fact that noise exposure hazards are of increasing significance due to the escalating production of noise in our technical society, people in the field of occupational and health safety are seeking to learn more about the invisible - audible hazard.

As of today, the role of long term exposure in causing noise induced hearing loss (NIHL) has been well recognized and research has progressed to the point where quantitative relationships have been derived between level and duration of exposure and degree of expected damage. In addition, extensive attention is being paid to the non-auditory effects of noise.

The factors that are believed to be critical in evaluating a potential noise hazard to the hearing are (1) overall level of the spectrum of noise (2) total exposure duration (3) time and frequency distribution of short term exposure periods and (4) susceptibility of an individuals ears to noise induced hearing loss.

Noise has both auditory and non-auditory effects. The auditory effects of noise have been extensively studied and include:-

- Permanent threshold shift: Seen after long term exposure to sound. The threshold of the individual is increased and this increase is permanent.
- Temporary threshold shift: There is a shift (increase) in the threshold of the individual, which is temporary. It is usually seen after exposure to noise

which is continuous but is of short term duration. Temporary threshold shift is reversible. However, persistent episodes of temporary threshold shift may give rise to permanent threshold shift.

- Acoustic trauma: Can take place due to the sudden impact of a very loud sound, the sudden increase in sound pressure level may give rise to irriversible hearing loss.

The non-auditory effects of noise: Noise is known to adversely effect people working in the industry causing annoyance, decrease in work efficiency, sleep disturbances, psychological distress; physiologic changes including changes in heart rate, changes in blood pressure, decrease in blood sodium level and increase in the protein cholestrol and magnesium levels in blood. But the most important non-auditory effect, is in fact a direct result of the primary auditory effect, that is, the obvious interference with speech communication due to the masking effects

Any noise in the industry can basically be classified into three types.

1. Steady wide - band noise: This is defined as the noise in which the energy is spread over a wide range of frequencies and is continuously emitted over an extended period of time.

An example is the noise generated in weave rooms.

2. Steady narrow - band noise:- In this,there is a concentration of noise energy in a narrow frequency range.

eg. Noise produced by circular saws.

Each of these noises could be intermittent or cyclic.

3. Impulse noise:- This type of noise is characterized by its short time duration created for eg. by explosions of drop hammers.

Because of the potential hazards of noise and its detrimentary effects on the hearing of the industry personnel, "Hearing Conservation Programs" were introduced. Most of the hearing conservation programs involve -

- Identification of work areas where noise is a hazard.
- Elimination of noise at its source whenever possible.
- Prevention of hearing loss among employees through.
- Providing for the detection of hearing loss before it becomes disabling.
- Providing protective devices for employees whose work is in areas where noise is of potentially harmful density.

Survey Research:

Wolman (1965) defines scientific research as an action producing truthful information about things and

what happens to them. This type of truthful information can be got by various methods of scientific research, and survey research is one of the most widely used scientific research methods.

The survey research can be conducted in many ways ranging from personal interviews, telephone conversations and observations to mail questionnaire studies.

The survey method is applied to many fields in behavioural and social research and to varied problems. The major advantage of this method is that, by using an instrument (for example a questionnaire) one can solicit responses from a group of respondents. Moreover it has great versatality and can be applied to large populations and a great deal of information got in a very short-time period.

Surveys may vary depending on their purpose. Scope, design and content of the survey research are all varied depending on the object of the study (Campbell and Katona, 1965).

Kerlinger defines survey research as that branch of social science investigations that studies small

and large populations by selecting and studying samples, chosen from populations to discover the relative incidence, distribution and inter-relations of sociological and psychological variables. Surveys carried out in this manner are sample surveys. From these samples, one can infer characteristics of population or the universe.

Surveys in the field of speech and heating:

Survey researches in the field of speech and hearing have been conducted over time.

The survey method has been used to meet various needs in the field of speech and language pathology as well as in audiology.

Curlee (1975) used the survey method to study the man-power resources in speech pathology and audiology.

Kapur (1966) conducted a survey of personnel equipment and facilities in India in the field of speech and hearing.

One of the surveys regarding the physically handicapped people (NCERT, 1968) indicated about the technical man-power and therapy equipment available in the area of deaf education information was collected via mailed questionnares.

Mahanda (1972) carried out a survey of noise and hearing patterns of an industry in Mysore city.

A survey of status of warble tone in audiogram was conducted by Staab and Rintelmann (1972), Balakrishna(1978) survey as a part of his masters dissertation was aimed at obtaining facts regarding education, training and employment of man-power in speech pathology and audiology.

Telford and Sawrey (1967) found that deafness caused 40% of the incidents of delayed speech and language developmental aphasia 26%, mental defi-ciency 25%, cerebral palsy 80%, and mental illness 10% in their survey on communication problems.

Ashok Kumar (1975) used the survey method to find out the problems of the hearing impaired children regarding scholastic achievement.

These are a few examples of survey research done in the field of speech and hearing.

Thus survey research does seem appropriate for collecting facts from a large group of people in as short a time as possible, about awareness of indu-strial Boise and its consequences from the employers.

The present study was designed as a small scale survey research of industries. The mail questionnaire was decided upon as the tool for the survey, which was carried out so as to find out.

a) Awareness of the potential hazards of noise to health.
b) Awareness of qualified personnel in the field to deal with the problems of noise.
c) The hearing conservation programs already in vogue in the industries.

Need for the study:

A survey of this type, which surveys the knowledge of employers of various types of industries, about noise in their respective industries and its consequences would serve a variety of needs.

a) To evaluate the risk to NIHL: A survey of the noise in the industry would give a fair idea of the intensity of noise; the distribution of intensity and frequency of noise in the factory, and the time duration for which each individual is exposed to on an average. These three factors would indicate whether or not a risk of HIHL exist, and if it does it also tell us the extent of the risk to hearing loss.

b) To determine adherence to noise criteria! In some situations it is necessary to evaluate the noise in the environment with regard to pre-established goals, codes, regulation or other rules governing noise criteria. Ideally the impinging noise should be less than the standards provided by the damage risk criteria. If more, then this could be used as a standard to evaluate the risk of NIHL

c) The survey is needed to find out the different types of noise in the industries: Depending on the types of noise one can plan out a hearing conservation program, as well as decide on the most appropriate type of the protective device that should be used by the workers in that industry.

d) The survey can be used as a method of evaluation of the complaints of annoyance, especially interference, decrease in work efficiency probable safety hazards,etc.

e) The survey serves as an excellent vehicle to find out if the industrial management is ware of the noise hazards in their factory and its potential hazard to the workers in the industry; and to tea whether they are aware of the availability of qualified persons for conducting regular evaluations of hearing ability, carrying out periodic

noise measurements in their factory and for initiating a hearing conservation program.

f) The sixth need of the survey was to find out if the industry management people were aware of the need for hearing conservation program. It aimed at finding out the number of hearing conservation programs currently in progress, the number of industries that were planning to initiate a hearing conservation program and those who were not aware of the availability of hearing conservation programs.

g) A further need of the survey was to see if the employers needed a "continuing education program" on - the potential hazards to health of noise, hearing conservation programs, and dispersion of ear protective devices as well as their compulsory use by employees.

h) The eighth necessity of the survey was to see if there was an increase among employers, awareness about industrial noise, its consequences and hearing conservation programs in the past decade.

So the basic need of the study was to get information about noise levels in factories, measures for noise control, awareness of noise hazards, incidence of health hazards due to noise in the industry, and to find out the awareness of employers about existence of qualified persons available for conducting hearing conservation programs.

Various studies have been carried out on Industrial noise and its effects. Westons and Adams (1932, 1935) were one of the first people to study the effect of industrial noise on workers. They studied the effect of noise on weavers. The noise of the loops in the wearing shed produced considerable noise which registered as 96 dB(A) on a sound level meter.

Westons and Adams performed three experiments:

(a) 10% of the weavers wore ear muffs which decreased the sound pressure level (SPL) at the ear drum by 10-15 dB, on alternate weeks, and recorded their output over a two week period.

(b) They equated two groups of weavers 10 in each group, with regard to past efficiency. Then one group wore ear plugs while working for a 6 month period, while the second group served as the control group working without ear plugs.

(c) They repeated the second experiment using different subjects but extended the experiment for over one year.

The results of this experiment were roughly the same - about 12% average increase in efficiency for those who were ear plugs to those who did not. The gain amounted to 1% increase in the material produced.

Tenkims (1935) published one of the most significant studies on the effect of industrial noise on workers. The study was carried out with the aim of finding out the effect of noise on the auditory capabilities of the workers. He carried out his study on a group of metal workers and the found that at the time of recruitment 83% of the workers could not hear a whisper from more than four meters away but after 15 years of work, none could hear a whisper even from four meters distance.

Larsen (1938) in making an exhaustive study of shipyard and factory labourers employed both whisper and audiology tests to find out their hearing abilities. He found hearing deficient in about 50% of the mean examined.

McKelvin (1941) found with whisper and voice test 25% of 100 textile workers had some form of deafness.

Rintelmann and Gasaway (1967) conducted a survey of hearing conservation program in representative aerospace industriesl. To obtain information concerning hearing conservation program was the primary purpose of the survey. Mail questionnaire were sent to 600 companies and the response was 56%. Returns indicated that 66% had no hearing conservation program and no plan to initiate such a program whereas 16% had complete

program of hearing conservation. The need for hearing conservation was recognised by 18% and 7% provided eqr protective devices for their employees who were exposed to noise. A comprehensive program of hearing conservation was being started by 3%.

Mahananda (1972) found that two sections of an industry in Mysore had noise predominantly high and in 12 sections noise spectrum was predominantly at low frequencies. In 10 sections of the factor the intensity of noise decreased with an increase in frequency. He stressed the need for periodic evaluation of hearing of factory workers exposed to continuous noise .

Bjorn Bergstrom and Bo Nystrom (1956) studied the development of hearing loss during long term exposure to occupational noise. The aim of the study was to see whether periodic hearing evaluations at a yearly interval were actually necessary for workers exposed to noise and secondly to see whether any other factors acting along with the noise would effect the hearing threshold shift more than what the noise alone mould effect.

They performed repeated hearing tests, over a 20 year period on 319 employees of a timber processing industry. The workers were basically involved in two types of activities - saw mill work and in paper pulp

production. There was a third division where the work involved working along with chemicals. The workers in the saw mill and paper pulp production division were basically exposed to noise levels of 95-100 dB(A) and in the chemicals division the mean noise exposure levels were much lower and were 80-90 dB(A). The type of noise was basically continuous noise with a very small content of impulse noise.

They concluded that noise induced hearing loss develops gradually when exposure levels do not exceed 100 dB(A), and the content of the impulse noise is small. Since annual changes which they found lay to a large extent within test-retest variability of industrial audiometry, they recommend three year intervals between the tests of hearing. However, in event of a substantial threshold shift, they said that repeated tests at a shorter interval were required and specialist consultation and transfer to less noise exposed work should be contemplated. They also found that exposure to industrial solvents and chemicals might be an additional factor contributing to the development of NIHL. A further comment made by them was that, initial hearing loss at more than one frequency within the

speech range increased the risk of developing NIHL.

The effect of noise on man was studied by Broadbent (1957), Kryton (1970). Yaffe and Jones (1961) recommended that the hearing conservation measures should be taken up when the noise level increased to 85 dB level.

Similar studies were carried out by Feton (1961),Carpenter (1962), Kryton (1950) suggesting minimum safe sound pressure level, which they place to be at 85 dB SPL.

Jenson(1960), Andrinkin (1961) had showed the physiological effects due to continuous noise exposure in factories on the workers.

Less and Roberts (1979 a) compared hearing levels and blood pressure level in a small industrial population exposed to high noise levels and could not find significant relationship between the two variables.

Doyan, et al (1979) in an effort to find out the physiological effects of noise on workers, matched factory workers exposed to 85 dB(A) SPL with workers in quieter environments. They reported that there was a significant correlation between the length of service in noisy factory and level of blood pressure.

They also found that level of noise exposure and level of diastolic pressure were related. In contrast to the studies cited above a relation between hearing loss due to noise exposure and blood pressure was also suggested. Substantially similar findings were also reported by Raffi et al (1980).

Other contemporary studies of variable merit have been performed under widely differing circumstances. They have resulted in positive findings including:

- Higher incidence of cardio vascular disease; in locomotive influences (Hammukari et al 1978).
- Elevated blood pressure in ship-yard workers (Fried Lander et al undated).
- Increased incidence of frank hypertension and hearing loss in noise alone and noise plus acetone exposure in chemical workers (Britanov, 1979).
- Increased incidence of sonic trauma (Demeter et al 1979) in coal briquette makers.
- Increased heart rate daring occupational noise as well as increased post recovery time related to a number of years on job (Lazaretta et al. 1979).
- Increased neuro vascular impairment proportional to exposure levels in workers in machine building industry (Suvarov, et al.1979).

Exposure levels in these groups of studies ranged from 70-79 dB(A) to 115 dB(A).

A number of relatively short term field studies have also been done Ising et al (1980 a) completed a well designed intervention experiment involving brewery workers. As one aspect of the study, workers in noisy parts of the brewery were fitted on half the days of the period of upto two weeks with hearing protectors so that each worker served as his own control. They showed modest but significant blood pressure and stress hormone percussor increase, during those days when the ear protection was not available. These investigators Ising et al (1980 b) also compared the cardio vascular and biochemical response in subjects who worked one day under high noise (85 dB(A) and one day in relatively quiet condition. Heart rate and blood pressure rose under these conditions as did urinary epinephrine CAMP, serum Magnesium, protein and cholestrol. Decreases in sodium and renin was also noted.

Peterson, Augestein et al (1984) reported that moderate high noise levels for four months produced sustained blood pressure elevation in rhesus monkeys. Subjects (monkeys) exposed to 85 dB(A) L_{eq} 24 noise for 24 hours for six months compared to control animals

who remained under low noise conditions exhibited a substantial increase in blood pressure and also manifested orderly change in the diurnal rhythm of heart rate. Blood pressure and pauses in cardiac rhythm were also seen. Their results conflict in detail with certain findings from earlier epidemologic studies. They however conclude that though their study examines the relationship between blood pressure and noise, and though the findings are reliable, since the study was done on a non-human species under a single set of conditions and for necessarily limited periods of time it cannot be concluded that noise produces. Cardio vascular disorders in humans. They state that before such a statement can be made further research on the topic is warranted.

Various lab studies have also been done to study the effect of noise. Andren et al (1980) indicated that short term exposure to stimulated industrial noise at 95 dB(A) produced systemic changes including significant increases in diastolic blood pressure, mean blood pressure and total rate of peripheral vascular resistance as well as slight decrease in systolic blood pressure or heart rate.

Gomez et al (1979) also demonstrated the possibility of differential effects by showing that during short

exposure to stimulus modelled after industrial noise at 90 dB(A) pulse rate, respiration and diastolic blood pressure were not changed but systolic blood pressure and galvanic skin resistance were changed.

Various studies have also been done to find out the susceptibility to noise induced permanent threshold shift and noise induced temporary threshold shift in workers in industries. After studies on animals it has been postulated by Mills (1975) that younger people are more susceptible than older people to auditory effects of noise on the hearing mechanism and that there existed a critical age beyond which the effects of noise on the hearing mechanism are reduced.

Totaland Bocci (1967) first introduced the concept of a relationship between the color of iris and noise induced temporary threshold shift and that brown iris color showed the greatest susceptibility to noise induced temporary threshold shift. However, the study of real world industrial workers and the study of effect of noise of the textile industry on 258 such workers by Augestein et al (1984) showed that the dramatic effect of the iris, seen during laboratory studies on hearing thresholds, had not been reflected.

So the authors concluded that the relation between the color of the iris and the real world

industrial noise effects and susceptibility to noise induced hearing loss could be dubious vis-a-vis the real world industrial settings.

Kumov, Fuller et al (1984) studied signal detection in industrial noise - effects of noise exposure history, hearing loss and use of ear protection. The aim of the their study was, to see whether the severity of hearing loss along with ear protective device usage had a significant role to play in the detection of signals. They concluded that the extent of hearing loss provided a great factor in deciding the type of ear protective devices that are to be worn by the worker. For workers who have a hearing loss less than some value between 35 and 65 dB HL will not be seriously handicapped when Hearing protectors in noise. But those with greater hearing loss may be advised to wear ear protective devices with lesser attenuation in order to maximize perception in noise while complying with regulations for hearing conservation.

As a part of a hearing conservation program, considering noise as a public health hazard, the Stockholm Health Conference was held at France. Dr.Gerd Jensen, Director of I.E.A. Germany who presided over the conference gave recommendations for national

and international institutions for noise control which were as follows:-

a) Vigorous measures were to be taken for control of traffic noise. Noise reduction at source for vehicles was advised, along with introduction of noise reducing road surfaces and to take measures to develop more quiet tyres.
b) To try to develop wore silent jet engines and to limit low flying.
c) There should be an obligation to indicate the sound emission to be expected of plants, equipments and implements, in the field of industrial and occupational noise in order to permit the estimation of industrial noise levels in environment.
d) They also recommend that minimum requirements of sound insulation be taken especially in common dwelling areas.

Balakrishna (1978) as a part of his masters dissertation carried out a study to find out the awareness among employers about noise and its effects. The main aim of his study was related to finding out the man power resources in the field of audiology and speech pathology. However in his 3-questionnaire

study he included a questionnaire for industry personnel which had the basic aim of checking out the audiology andspeech personnel working as industrial audiologists,it also included questions to get information about noise levels in factories, measures for noise control, awareness of noise hazards, incidence of health hazards in factory and awareness of qualified personnel available for conservation programs.

Fifty questionnaires were mailed to industries in Karnataka state. The industries were picked randomly and care was taken to see that every industry got an equal opportunity for selection in the sample. Various types of industry including textile industry, food products, beverage industry, instrument and tool industry, animal feed industry ceramic and porcelain industry were all included. Response level was 40% and came from 20 factories producing 14 types of goods.

His data revealed that majority of the individual management were aware of the adverse effects of noise on the health of the workers, but they did not know the availability of qualified persons in the field of hearing conservation. However some of them were willing to depute their staff for training in hearing evaluation and noise control.

The noise level in some of the factories were reported to be so high that workers could not hear each other even if they spoke aloud. Most factories had continuous noise but a few of them reported having intermittent noise. A few percentage of the textile workers were provided with ear muffs to protect their ears.

Data did not show any incidence of health hazards due to noise exposure. Information regarding compensation paid to the workers in case of health injury was not given. However a few of the industries were willing to have periodic hearing evaluation of factory workers.

However, he recommends that a similar questionnaire be given to the employers and the results compared, in order to check the validity of his study.

METHODOLOGY

A) Survey design:

The survey was designed so as to obtain clear cut information about the types of noise in industries, awareness of the consequences of noise and its potential hazards to the health of the workers. Measures of noise control in use in the various industries, and the awareness of the availability of qualified personnel in the field of noise measurements, noise control and hearing conservation programs.

The survey was designed as a small scale study. The data was obtained with the help of a mail questionnaire. The mail questionnaire was specially developed, so that all pertinent information could be collected effectively.

B) Preparation of questionnaire:

The questionnaire was prepared so as to obtain all information that was necessary, from the manufacturing industries of Karnataka state. The intention of the questionnaire was basically three fold:

(a) To see whether the management was aware of noise and its potential hazards to health

(b) To check whether the employers follow a hearing conservation program in their industry.

(c) To know whether they are aware of the availability of trained man-power in the hearing conservation area.

The questionnaires were mailed to the personnel managers of the industry who were requested to furnish all necessary information. 25 questions were included in the questionnaire (Appendix-B) which covered five major aspects of intetest - which included general information, technical information, measures taken for conservation, awareness of noise hazards and technical man -power :

(i) General information: The category on general information consisted of questions on, type of industry, material manufactured, the number of employees, the working hours of the industry per day and the total number of shifts.

(ii) Technical information: The category pertaining to technical information posed questions about the type of noise in the factory, the level of noise in the factory, the number of persons exposed to noise and the duration of exposure to noise, the source of noise in the factory, areas in the factory where noise was highly prevalent, incidence of hearing loss, other health problems as well as the non-auditory effects of noise in the factory.

(iii) Measures taken for conservation: The measures taken for hearing conservation was dealt with, as the third aspect of the questionnaire. The questions in this category dealt with pre-recruitement hearing evaluation, periodic hearing evaluations made in the factory - the necessity, frequency and the results, noise level measurements made in the factory, whether the management despersed ear protective devices among the employees and the various other measures for noise control taken up by the management.

(iv) Awareness of noise hazards: Awareness on the part of management and workers on the noise hazards and the availability of techniques to prevent and control noise was enquired. A question regarding the compensation paid was also asked.

(v) Technical man power job opportunities in the area of hearing conservation program in industries was the next area of survey.

The two major questions were: Whether the management was aware of qualified persons for hearing evaluation, noise measurement and introduction of hearing conservation program and secondly whether the management was ready to employ such persons.

This aspect of the survey questionnaire would also give answers to the question as to how many audiologists were working in the industries as industrial audiologist.

Information about the industries in Karnataka state wax got from the 1984 edition of the Times of India Directory

(C) Covering letter (Appendix-A):

A covering letter was sent along with every questionnaire. The covering letter covered aspects like purpose of the survey which was conducted. The person who was conducting the survey - Detailed instructions were also provided as to, how to fill the questionnaire. Instructions were also given about the additional space provided for additional comments, informations or specifications that had to be made regarding the answers. The covering letter was addressed to the personnel manager of the factories. An assurance of confidentiality of information received was also made in every letter.

(D) Subject selection:

Fifty manufacturing industries in Karnataka state formed the subjects of the study. The fifty industries

were picked out randomly from the list of industries in the Times of India Directory (1984). The industries selected were from four major areas - automobiles and auxiliary parts. Textiles industry; timber products and tiles. The fifty industries were picked up from these four areas using proportional sampling. Hence there were ten industries each from textiles, timber and tile industries and 20 from the automobile and auxiliary parts industries.

Industries in Karataka were selected because of their accessibility so that the necessary information could be collected without much loss of time and a follow-up if necessary could be conducted more effectively and easily.

The questionnaires were mailed to the personnel managers of the various industries who were requested to furnish the required information and mail the questionnaire back at their earliest.

(E) Confidentiality:

High emphasis was placed on the personal anonymity and confidentiality of the information sought. Every questionnaire was accompanied by a covering letter which assured the respondee of total anonymity and the

use of the information given only for analyzing the trends in the field of industrial noise and its consequences. They were also assured that the study was purely of academic interest.

(F) Mailing procedure:

Each questionnaire along with the covering letter and detailed instructions was mailed to the personnel manager of the selected industries. A self addressed stamped envelope was also included so as to assure a prompter reply and as a means of assuring a higher return of filled questionnaires.

(G) Follow-up:

Three weeks after the first sending of questionnaires a second letter was sent to the industries from where there was no response as a reminder. In some cases a second follow-up letter was also sent two weeks after the first follow-up letter.

Incase of local industries telephonic reminders also served as follow-up for ensuring returns of questionnaire.

(H) Data processing:

Once the necessary information was got the questionnaires were then sorted out for analysis. The questionnaires were separated based on the different types of industries and different types of goods produced. All the unfilled questionnaires were placed separately and only the fully filled questionnaires were considered in the analysis of data.

RESULTS

The findings of the survey were tabulated and the results were analyzed.

Of the fifty questionnaires sent, thirtythree were returned fully completed. The response rate was 66% . Following is the distribution of the return of questionnaires from the various industries.

Questionnaire sent to	No. of mailed	No.of returned	Percentage returned
Automobile	20	16	80%
Textile	10	5	50%
Timber	10	6	60%
Tiles	10	6	60%
Total	50	33	66%

Table-1: Distribution of the number of industries to which the questionnaires were mailed and percentage returned.

Data pertaining to each aspect of the study was then analyzed. Analysis was done as a group and also among industries.

The general information was first analyzed. This included analysis of the type of industries, their products and number of workers.

33(a)

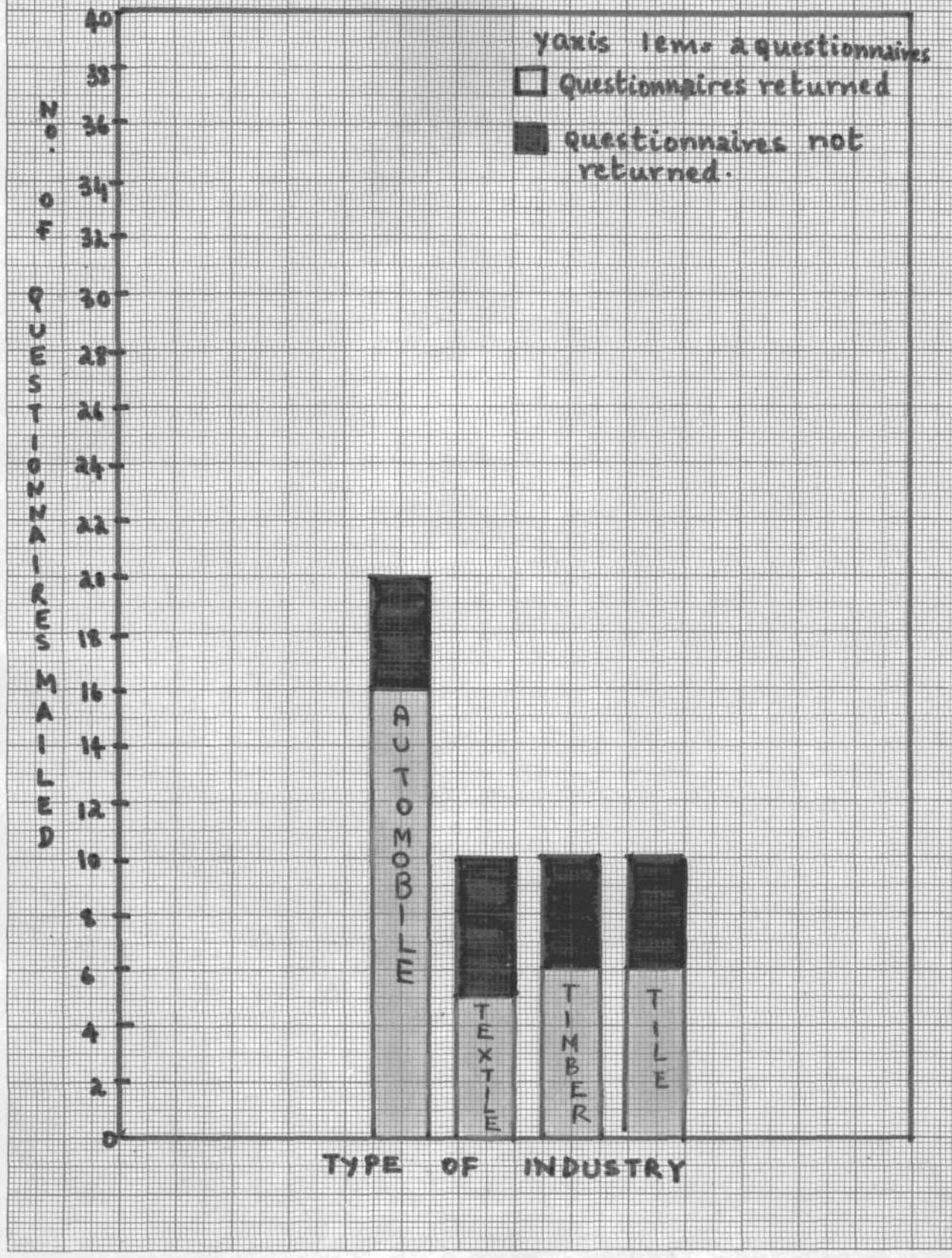


Fig 1: Showing number of Questionnaires sent and the

Table-2: Distribution of workers, products and nature of industries.

Types	Products	Nos.	No.of workers
Automobile and auxi-liary parts industry.	Spring leaves and assemblies	4	1773
	Ironcastings	1	350
	I.C. Engine valves	2	870
	Spring steel	1	285
	Tyres and tubes	2	1980
	Heat exchangers and pressure valves	1	100
	Rubber molded components	2	1575
	Pistons	2	1225
	Motorbikes	1	850
	Total	16	9008
Textiles	Cotton mills	4	8520
	Garments	1	200
	Total	5	9720
Timber	Plywood products	1	100
	Saw mills	3	75
	Furniture products	2	500
	Total	6	675
Tiles and marble	Decorative laminates	1	200
	Tiles	5	1000
	Total	6	1200
	Grand Total	33	20603

a) There were 33 factories from 4 selected categories producing 16 types of goods.

b) Number of workers: There were about 20,603 workers distributed among 33 factories. Maximum number of workers were seen in cotton mills and in the automobile industry. The textile industry appears to have the highest percentage of workers, followed by the automobile industry.

Table-3: Percentage of workers of an average in each type of industry.

Industry	Percentage of workers
Automobile	43.72 (16 industries)
Textile	47.2 (5 industries)
Tiles	3.2 (6 industries)
Timber	5.8 (6 industries)

c) Products: Different types of products were manufactured including spring leaves and assembles. Iron castings. I.C. engine values, spring steel, tyres and tubes, heat exchangers, pressure valves, rubber molded components, motor bikes, cotton, ply-wood products, furniture, saw-mills, decorative laminates, tiles etc. The type of products and their distribution is given in Table-2.

The data shows that there are high number of workers in textile industries, and in spring leaves

industries, engine valve industries, tyre industry and in most other automobile industries.

d) Duration of work in industry per day. All the industries had workers working for 8 hours a day with a half an hour lunch break. Most of the automobile industries had 2 to 3 shifts and some had even four shifts but all the shifts were of 8 hour durations. The textile mills all had two shifts, each of 8 hour durations. In the timber and tile mills - there was only one shift of 8 hours duration.

2. Technical information: This included information about type of noise, duration of noise exposure, number of persons exposed, noise level in factory areas of noise prevalence and incidence of hearing loss.

a) Type of noise in the factory: The type of noises differed in the different types of factories. In automobile industries it was seen that mostly continuous noise abounded with intermittent noise prevailing in certain factories like those manufacturing spring iron, pressure valves, etc. in textile mills continuous noise was the only type of noise seen. In timber mills intermittent noise was seen most of the time with occasional impulse

3(a)

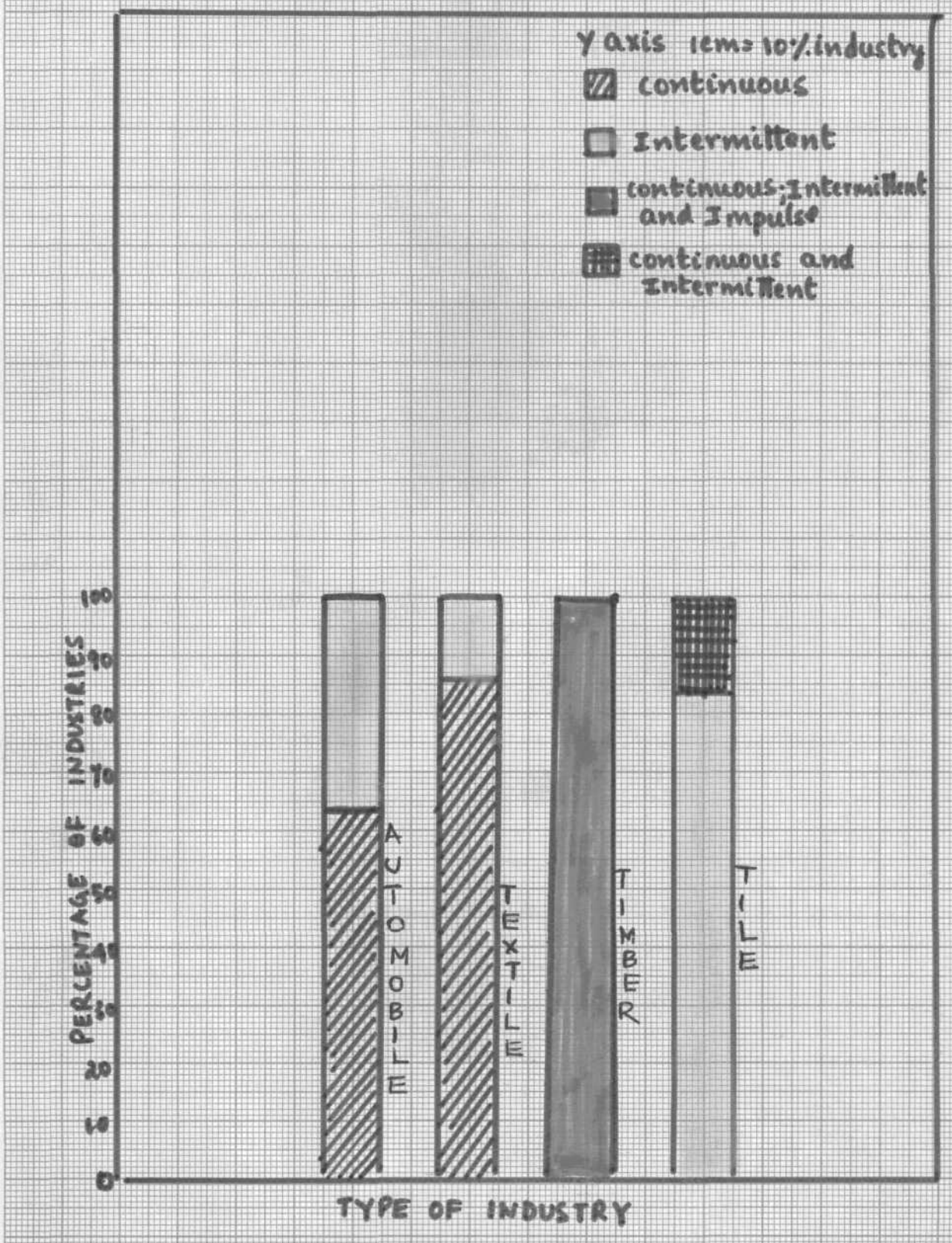


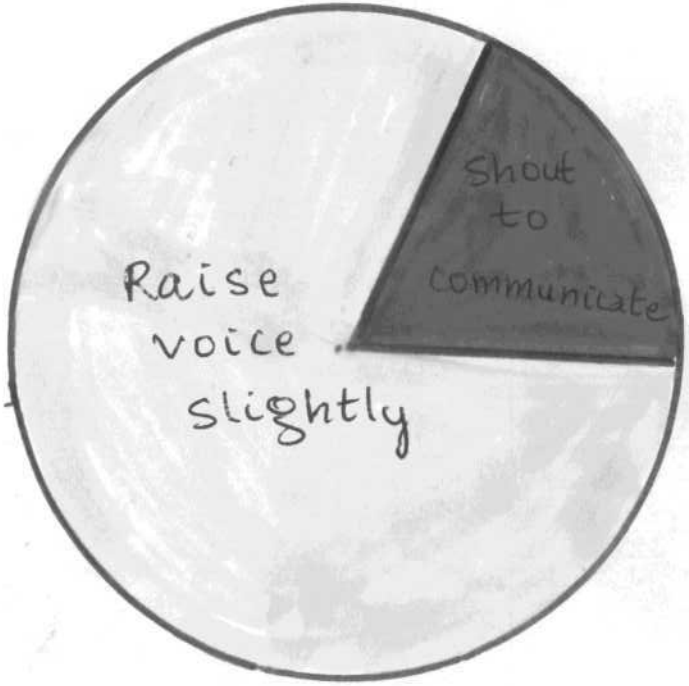
Fig 2: showing type of noise prevalent in factories

noise and moderate amount of continuous noise. In the factories manufacturing tiles intermittent noise predominated.

Table-4: Percentage of factories distributed with respect to type of noise.

Type of noise	Automo-bile	Textile	Timber	Tiles
Continuous only	62.5	86	–	-
Intermittent only	37.5	–	-	84
Impulse only	–	–	-	-
All three types	–	–	100	-
Continuous & intermittent	–	14	-	16
Intermittent and impulse	-	-	–	–
Impulse and continuous	-	–	-	-

b) Noise level in the factory: The information available was very varied. In automobile industry almost all reported that easy communication within 3 feet distance was impossible. 87.5% reported that it was essential to raise their voice to be heard in most areas. In certain areas like the generator room all respondents reported that it was difficult to hear even when speaking at top of their voices.



(a) In most areas

(b) In certain areas like generator room.

Fig 3: Effect of noise on communication in automobile industry

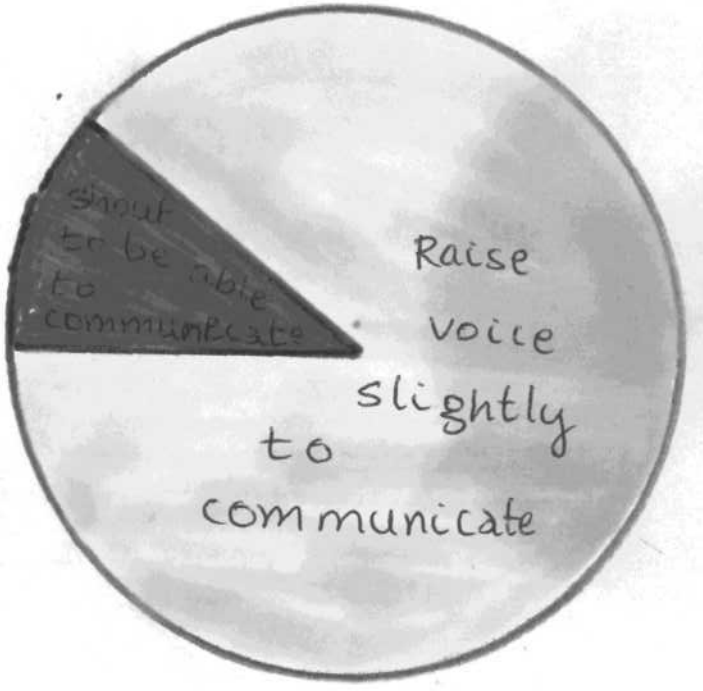


Fig 4: Effect of noise on communication in Textile Industry

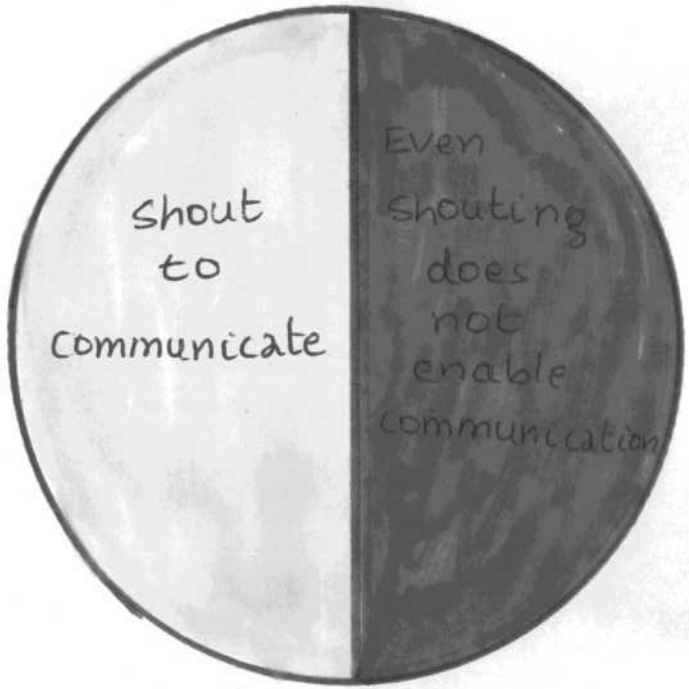


Fig 5: Effect of noise on communication in Timber industry

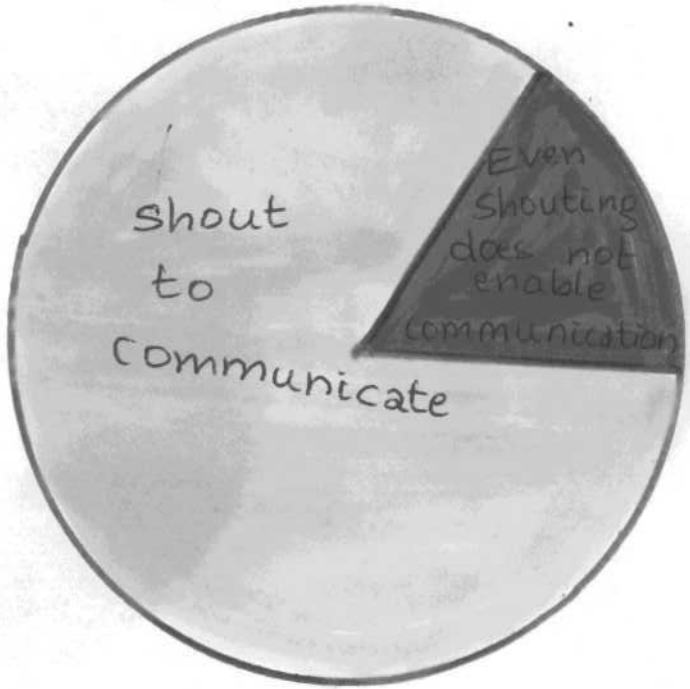


Fig 6: Effect of noise on communication in Tile industry

In the textiles factories again easy communication within 3 feet distance was reported impossible 80% had to raise their voices slightly to communicate whereas 20% had to shout to be heard. In the tile industry 83.33% reported that they had to shout to be heard whereas 16.6% found it difficult to communicate even when shouting at top of their voices. The timber industry reported a total inability to communicate even when shouting in certain areas like the beater room whereas in other areas slight increase in voice was enough to be heard.

Table-5: Distribution of factories based on effects of noise on communication.

Noise index	Automobile	Textile	Timber	Tile
Easy communication possible within 3 feet.	- -		-	-
Raise voice slightly	87.5%	8%	–	-
Shout to be able to communicate	12.5%	20%	Certain areas (100%)	83.33%
Not able to communicate	certain areas like generator room (100%)	-	certain areas (100%)	16.6%

c) Duration of noise exposure and people exposed to noise: Data revealed that on an average 40% of the workers were exposed to continuous noise and about 30% to intermittent noise about 2% of the

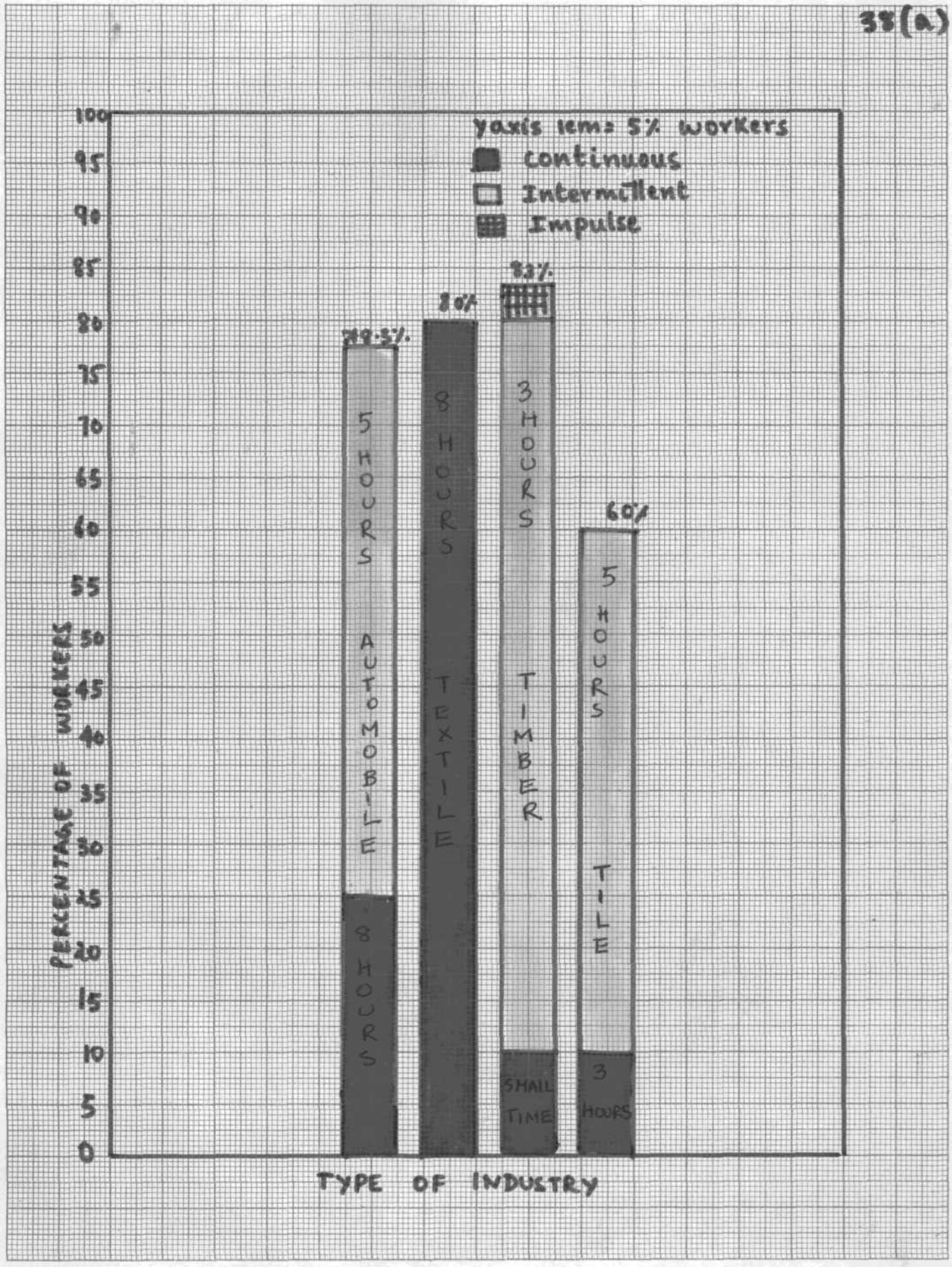


Fig 7: Showing exposure to different types of noise for different durations by the workers in different industries

workers were exposed to impulse noise. It was seen that 25% of the automobile workers on an average were exposed to continuous noise for 8 hours whereas 53.3% of the workers were exposed to intermittent noise on an average of 5 hours per day. In the textile industry it was seen that 80% of the workers were exposed to continuous noise for almost 8 hours a day. In the timber industry 70% of the workers were exposed to intermittent noise on an average of 3 hours per day whereas 10% were exposed to continuous noise for a small time. A very small percentage was also exposed to impulse noise for a very short period of time. The tile industry had 50% workers exposed to intermittent noise for 5 hours on an average and 10% to continuous noise for 3 hours per day.

Table-6: Shows the distribution of percentage of workers depending on exposure duration to different types of noise

Noise	Automobile	Textile	Timber	Tile
Continuous.	25% (8 hours)	80% (8 hours)	10% (Small time)	10% (3 hours)
Intermittent	53.3% (5 hours)	-	70% (3 hours)	50% (5 hours)
Impulse	--		small % small time	-

d) Incidence of health hazards: There was no report of incidence of hearing loss due to exposure to noise. However, in one textile industry, the respondent reported that one worker developed a hearing loss after an accidental explosive in the factory. About 6% of the respondents from the automobile industry complained of pain and fatigue whereas 33.3% of the tile industry respondents complained of ringing sounds in their ears (tinnitus). No other complaints about health was seen in any of the other industries.

3. Measures taken to prevent noise hazards: under this aspect data was collected to give information about 3 aspects:
   (a) Hearing conservation programs
   (b) Measures taken to control noise
   (c) Personnel noise control - ear muffs, ear plugs, etc.

Data revealed that only 12% of the industries had complete hearing conservation programs which included hearing evaluation at time of recruitment, Annual hearing evaluation programs, regular noise measurements in factories and supply of ear protective devices. 15% of the industries had carried out hearing evaluations and provided ear protective devices but only to the workers in the high noise area.

25% of the automobile industry had proper hearing conservation programs. Ear muffs were dispersed among workers in the arc furuance area, rolling mill stands and generator rooms whereas 12.5% had heating evaluations and 6.25% gave ear muffs, 6.25% gave ear-plugs in the textile industry 60% of the industries gave ear muffs and hearing evaluation was done but not on a regular basis.

All hearing evaluations were carried out by the factory medical officer. 48.5% of the factories do not have a medical test at the time of recruitment. In the tile industry almost 33.3% reported that the workers on their own use some sort of ear protection like cotton wool. No hearing evaluations had been made though the management feels the need for having such evaluations made.

The percentage of timber industry, which provided ear plugs to its workers was 16.6%. In 66% workers used cotton plugs on their own. 16% of the respondent did not feel the need for hearing evaluation and 83.3% reported that they would like to have such evaluations. Noise measurements were made by government factory offices.

Table-7: Distribution of factories based on noise control and hearing conservation measures.

Measures	Automobile	Textile	Timber	Tile
Total hearing conservation program	25%	-	-	-
Hearing evaluation	12.5%	60%	-	-
Ear protective devices.			-	-
- Ear muffs	31.25%	60%		
- Ear plugs	6.25%	-	-	16.6%
- Cotton wool	-	-	33.3%	60%
Noise measurement.	As a part of conservation (25%)		-	-

Measures taken for noise control were many. 18.75% of the automobile industries reported that high compound walls were built on the perimeter of the company to control environmental noise. Moreover generator rooms were located for away from the compound walls. No other industry has reported of such measures taken for noise control. In the automobile industry 31.25% of the respondents reported that the workers were rotated from noise intensive areas to relatively silent areas regularly to control the potentially hazardous effects of noise.

37.5% of the automobile industries and 50% of the textile industry reported of introducing shift systems with each shift of total 7 1/2 hours working duration, in order to reduce the workers total exposure to noise.

Personal protection from noise: It was seen that ear protective devices were provided by 30.3% of the industries to 20% of the workers on an average. 24.2% of the industries provided ear muffs whereas 6% provided ear plugs. In 18% of the industries workers used their own form of ear protection like cotton wool.

37.50% of the automobile industry provided ear protective devices. 31.25% gave ear muffs and 6.25% gave ear plugs. Ear muffs distributed, were only to workers in noise intensive areas like generator room, near arc furnace area, rolling mill stands etc. The textile industry, had 60% of its industry providing ear muffs to its workers. 33.3% of the tile industry and 66% of the timber industry personnel used some sort of ear protection on their own 16.6% of the timber industries provided ear plugs to their workers. 45.45% of the industries wanted to disperse ear protective devices but were unaware of the procurement source tor such devices in India.

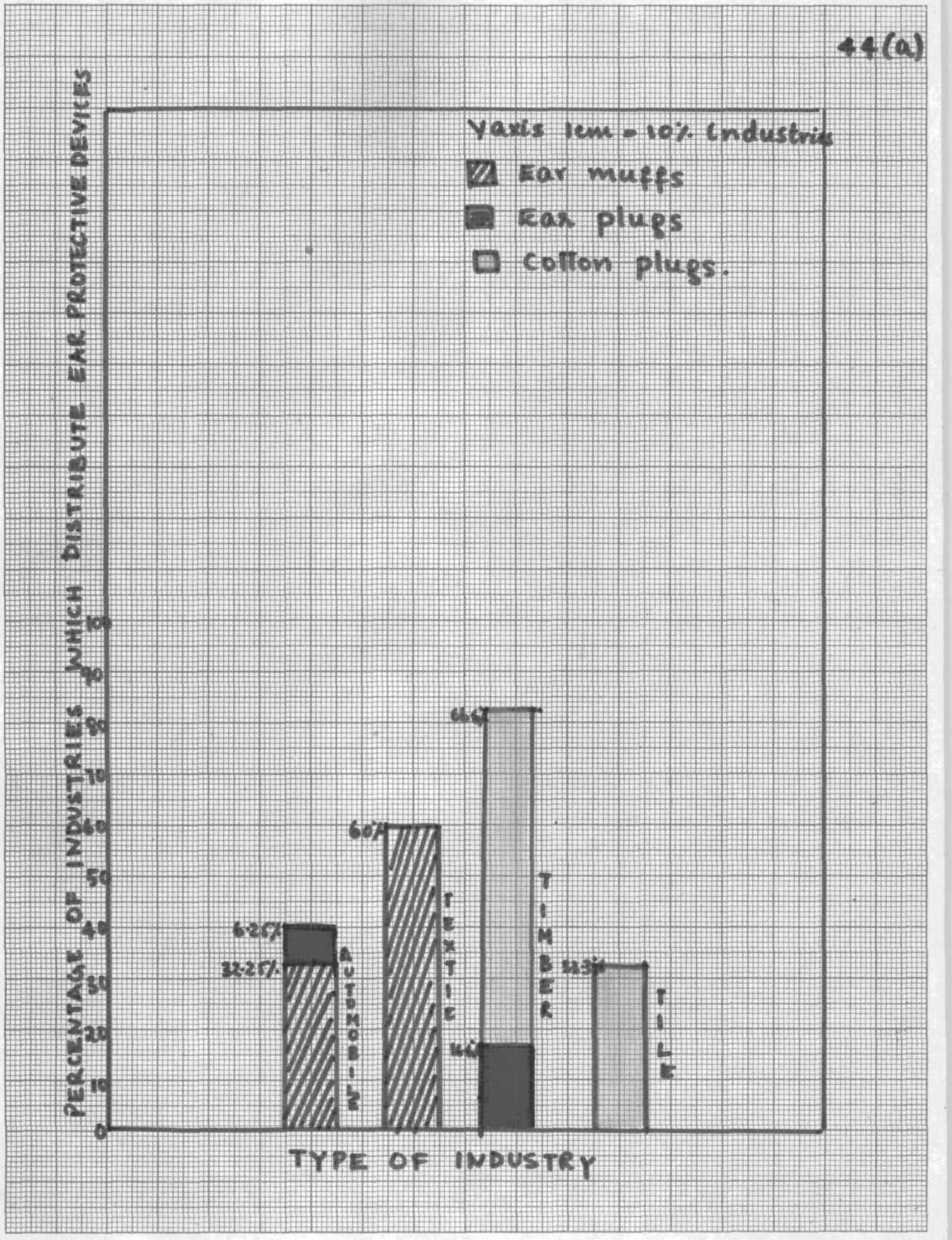
Table-8: Ear protection devices distribution among the various industries.

Ear protection devices.	Automobile	Textile	Timber	Tile
Ear muff	31.25%	60%	–	–
Ear plug	6.25%	–	16.6%	-
Cotton plugs	-	-	66.6%	33.3%
Others	–	-	–	–

4. Management awareness: Awareness of noise hazards, awareness of specialist in hearing conservation programs and compensation paid for health injury are provided in this section.

a) Awareness: Data received showed that almost 100% of the respondents knew about the health hazards due to noise. All the respondents knew about the effects of noise on hearing. However, only about 65% of the respondents knew about the non-auditory effects of noise.

Data also showed that there was a high awareness about specialists in the field of hearing conservation. 100% of the automobile industry management and textile management knew that there were specially qualified people to carry out hearing evaluations and noise measurements in the industry. However, all hearing tests were done by the factory medical officers and all noise



Figs: showing the percentage of industries distributing various ear protective devices.

measurements by the government factory supervisor. In the timber industry 33.3% of the industry management was not aware of people qualified for making noise level and hearing evaluations. 50% of the tile industry is not aware of the source of procurement of ear protective devices. They were not aware of people qualified to carry out hearing conservation programs but knew about people specially qualified for hearing evaluations.

b) Compensation: No industry reported to paying compensation due to long term exposure to noise of their workers. However, one industry dealing with textiles reported having paid compensation to one of its workers whose hearing was damaged due to an accidental explosion in the factory. However, amount paid as compensation is not mentioned.

5. Needs of management: About 57.5% of the industrial management excluding those who already had a fully fledged hearing conservation program were willing to have periodic hearing evaluation of the workers. 51.5% were ready to have periodic noise measurements in their factory.

About 45.43% of the industrial management wanted to know about the source of procurement of ear protective devices, the different types of ear protective

devices and their uses. 9 % of the industries wanted to start a full fledged hearing conservation program. 3% of the industries did not find the need for a hearing conservation program. 3% did not have the necessary budget to carry out such a program though they felt the necessity of such a program.

About 48.48% of the industrial management were willing to depute their staff for specialized training in hearing evaluation and noise measurement. However most of the respondent reported that they would prefer having already specially trained personnel evaluate hearing and measure the noise level in the factory. Only 9% of the industries were ready to have such specially trained personnel on their staff. 51.5% wanted such trained personnel to carry out noise measurements in their factories, whereas 9% wanted them to carry out full hearing conservation programs. 57.5% wanted them to carry out annual hearing evaluations of their workers.

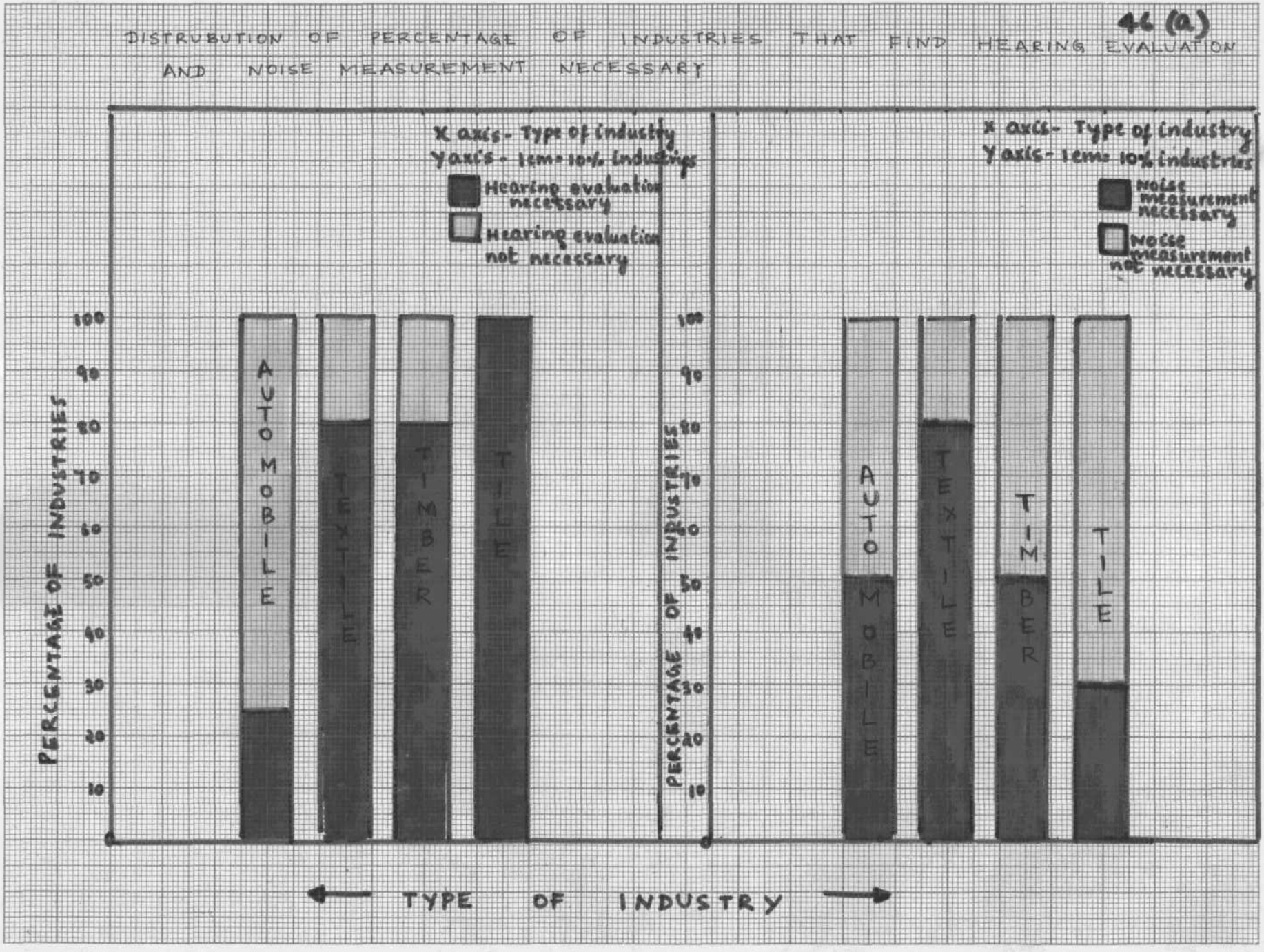


Fig 5 Distribution of percentage of industries that find hearing evaluation and noise measurement necessary.

Table-9: Distribution of needs of factory management

Industry	Hearing evaluation necessary	No evaluation necessary	Evaluation necessary no budget	Hearing conservation program	Source of ear protective devices procurement.	Noise measurements.
Automobile	25%	-	-	18.75%	18.75%	50%
				-	20%	80%
Textile	80%	-	-	-	83.3%	50%
Timber	83.3%	16.6%	-	-	100%	33.3%
Tile	100%	-				
Total percentage among all industries	57.5%	3%	16.6% 3%	9%	45.4%	51.5%

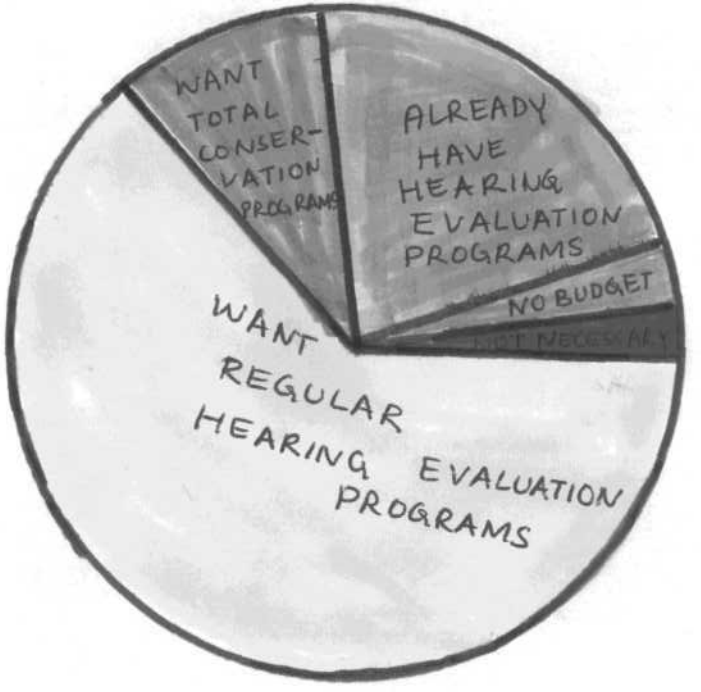


Fig. 10: Showing the needs of the management

DISCUSSIONS

Exposure to noise is potentially hazardous to hearing and health. Noise creates both long term and short term effects. These effects can be both auditory and non-auditory. However, the damaging effects due to noise can be prevented and controlled to a very large extent. The data revealed that 100% of the respondents knew about health hazards due to noise. All the respondents knew about the effects of noise on hearing. However only 65% of the individual management was aware of the non-auditory effects of noise.

Balakrishna (1978) reported that the majority of industrial management was aware of the adverse effects of noise on the health of their workers, but they were not aware of qualified persons in the field of hearing conservation. However, the present study showed that there is significant awareness among the industrialists, especially in automobile and textile industries, about specially qualified persons available for carrying out hearing conservation programs. A small percentage of the timber industry was not aware of people qualified for such

programs. A section of the tile industry was aware that there are people specially trained to carry out hearing evaluation, but were not aware of hearing conservation program specialists.

The awareness of the health hazards of noise has made almost all industrialists reduce the duration for which each worker was exposed to noise. It is seen that a major portion of the automobile industry uses 2-4 shifts of 8 hours each.- Work shifts even in the timber and the industries were not seen to exceed 8 hours.

The type of noise seen differed in the different type of industries. Continuous noise predominated in both automobile and textile industry with intermittent noise forming a part of the noise in both these industries. Timber industries had continuous, intermittent as well as impulse noise in small quantities. Intermittent noise predominated in the industries with small amount of continuous noise. This data is consistent with Balakrishna (1978) study where he found that most factories had continuous noise but a few of them were reported having intermittent noise. He also found that the noise level in some of the factories was so high that workers

could not hear each other even if they shouted. However, the present data revealed that such a situation was seen only in relatively high noise areas like the generator room, near arc furnance, beater room etc. In the automobile and textile industries in most of the other areas a slight increase in loudness was necessary in order to communicate whereas in the tile and timber industry it was seen that, in majority of the industries the workers had to shout to be able to communicate.

In most of the industries only a fraction of the workers were continuously exposed to noise. The majority, were the textile workers 80% of whom were exposed to continuous noise for 8 hours as against 25% of automobile workers exposed for the same duration and 10% of both timber and the workers exposed for a shorter duration.

None of the textile workers were exposed to intermittent noise for a significant duration. However, almost 53% of automobile workers and 50% of the tile industry workers were exposed to the same for 5 hours, and 70% of the timber workers were exposed for 3 hours.

No incidence of hearing loss due to noise exposure has been reported in the data. However, one worker in a textile industry is reported to have lost his hearing after an accidental explosion. A very small portion of the automobile industry complained of pain and fatigue due to noise whereas a part of the tile industry complained of ringing noises in the ear. No details on compensation paid were available.

Data from the 1978 Balakrishna's study revealed that only a small percentage of the textile workers used ear muffs. The situation seems to have considerably improved since then. Though only 12% of the industries carried out total hearing conservation programs which included annual hearing evaluations, regular noise measurements and supply of ear protective devices and 15% carried out both hearing evaluations and distribution of ear protective devices, most of the industries provided ear protective devices. A major portion of both textile industries and automobile industries provided ear muffs. A small portion of automobile industries and timber industries dispersed ear plugs. Almost 33% of the tile industry had workers who used cotton plugs as protective devices. A major

portion of the industries (46%) were unaware of procurement sources for such ear protective devices in India, but were ready to disperse such devices among workers if they were procurable.

A majority of the industries had introduced shifts of 7 1/2 hours each of total work duration in order to reduce total exposure to noise. About 31.25% of the automobile industry rotated workers from noise intensive to relatively noise free areas to control the adverse effects of noise, another 18.75% also reports of building high compound walls, planting trees and locating generator room far from the actual factory to control the effects of noise.

A major portion of the industries felt that hearing evaluations were necessary and were ready to have such evaluations made. About 9% of the industries were ready to start a full fledged hearing conservation program. Almost 51.5% of the industries were ready to have periodic noise measurements made in their factory. A major portion of the industrial management was willing to depute their staff for specialized training in hearing conservation programs. However, most of them reported that they preferred having already trained personnel to come

and carry out hearing and noise evaluations. However only a very small percentage of the industries were ready to have such trained personnel on their staff.

The data show a definite increase in awareness of noise hazards and an increase in hearing conservation, noise control and prevention measures since Balakrishnas (1978) study. However, the data was received from the employers, Since the aim for the study was to find employers awareness of noise and its consequences; whether the workers would answer similarly to such a questionnaire needs further investigation.

SUMMARY AND CONCLUSIONS

The survey was designed so as to obtain information about the awareness among the employers about noise in their industries and its consequences.

The investigation was mainly carried out along three main lines:

- whether the management was aware of noise and its potential hazards to health
- whether the employers followed any hearing conservation programs in their industries
- whether the management was aware of specially trained professionals in the area of hearing conservation.

The data was obtained with the help of a mail questionnaire that was specifically developed to obtain all pertinent information effectively.

The response rate was 66%. With fully filled questionnaires being returned from 33 of the 50 industries to which the questionnaire was mailed.

The 25 questions in the questionnaire, collected information from 5 major areas of interest which included general information like type of industry, number of workers, products made, working hours etc.

Technical information including type of noise, level of noise, number of persons exposed to noise, duration of exposure etc. The third aspect dealt with measures taken for noise control and hearing conservation. Awareness of noise hazards both auditory and non-auditory and technical man-power, job opportunities were the final aspects of the questionnaire.

The questionnaire was sent to the management of the industries with the aim of finding out whether the management was aware of health hazards due to noise exposure, whether they had implemented hearing conservation program in their industries and whether they need trained personnel in the area of hearing conservation program. Necessary information was collected through the questionnaire.

Data collected were tabulated and analyzed. Appropriate percentages were computed and graphically presented.

The following conclusions seem warranted. Industrial management seems to have a high awareness of noise and its effects. Awareness of auditory effects of noise is more than the awareness of non-auditory effects. Though a large portion of the industries were aware of qualified personnel available for carrying out

hearing conservation program all the hearing evaluations done in the industries were by the factory doctors, and all noise measurements were done by the government factory officer.

A small portion of the industries it was seen had full fledged hearing conservation programs in vogue which included hearing tests at time of recruitment, annual hearing evaluations, noise level measurements periodically and ear protective measures. A slightly higher percentage carried out both hearing evaluation and dispersed ear protective devices. On the whole a high percentage of the industries provided ear protective devices which included ear muffs and ear plugs. However, a large percentage of the industries (most, being from the tile industry) were unaware of the source of procurement of such ear protective devices and were keen on knowing the source of procuring these devices. This along with other measures like rotation, of personnel, location of high noise areas away from the concentration of personnel areas, introduction of shifts to curtail duration of noise exposure all show that the employers are becoming increasingly aware of the potential hazards of noise to health and are introducing measures to control noise and reduce its adverse effects on the health of the workers.

A large portion of the industrial management is aware of the presence of qualified personnel to carry out hearing conservation programs, however, only a very small percentage is willing to have them on their full time staff, basically because of budget limitations. A large percentage are willing to have both hearing and noise evaluations performed periodically in their factory and prefer having qualified. personnel perform such evaluations. This shows that there is a high necessity for trained personnel who are specially qualified in the area of hearing evaluation, noise measurement and hearing conservation.

The study also high lights the fact that though there is an increase in awareness about industrial noise and its consequences, further education is essential about hearing conservation and employers need to be given adequate information about ear protective devices and the sources of their procurement.

Suggestion for further research:

1. The present survey is a small scale study and highlights the need for a larger study on the same lines, extending to include more areas, more industries and covering industries from a wider geographical area.
2. A periodic survey of noise and exposure to it, would be useful for planning of hearing conservation programs.
3. A survey which involves similar questions but addressed to the workers would give additional information and help confirm the results of studies like the present study.
4. A survey of man-power resources for hearing conservation available in industrial area also provide useful clues of job facilities available and training programs necessary.

BIBLIOGRAPHY

Anndren, L., Hamson, L., Bjorkmann, M., and Johnson, A., (1980): Noise as a contributory factor in the development of elevated arterial pressure, Acta Med.scand. 207, 493-498.

Ashok Kumar (1975): Survey of problem of hearing impaired children regarding scholastic achievement in normal schools. Unpublished Master degree Dissertation submitted to Mysore University.

Balakrishnan. E.P. (1978): Man-power resources and needs in the field of speech and hearing. Unpublished master degree dissertation, submitted to Mysore University.

Bergstrom, B., and Nystrom, B. (1986): Development of hearing loss during long term exposure to occupational noise. Scan. Aud. 15(4), 227-234.

Britanov, N.C., (1979): Effect of noise and acetono on female workers in acetate and poly vinyl chloride fibre factories. Gig Truda i Prof Zabovel aniia, 2(12), 15-19.

Broadbent, D.E. (1957): Effects of noise on behaviour (Chapter-20), Handbook of noise control, McGraw Hill Book Co.

Campbell, Katona, (1966): Research methods in behavioural sciences (Chapter-1), Ed. Festinger, L., and Katz, D., Holt Rinehart Winston Inc.

Carpenter, A. (1967): Effects of noise on performance and productivity. Ass CNS symposium, 12, 297.

Cohen, A., Taylor, W., Tubbs, R. (1980): Occupational exposure to noise, hearing loss and blood pressure, ASHA Reports, 23, 322-326.

Curlee, R. (1975): Man-power needs in speech pathology and audiology, ASHA, 18.

DeJoy, D. (1984): The non-auditory effects of noise-review and perspectives for research, J.of Acou.Res. 24(12), 123-150,

Demeter, L.D., Cherestes, I., Kertesz, I., and Demeter, E. (1979): The inter relation between sonic trauma and arterio sclerosis. Arch. Oto.Rhino Laryn. 24(3), 197-203.

Doyon, B.D., Rudex, J.A. (1979): Effects of noise on blood pressure, Coeut et Med Interne, 17, 61-71.

Friedlander, B., Gerbemann, M., Wathen, G., Riedlerus (undated): Analysis of noise in its relation to blood pressure in the industrial population; Maryland State Dept. Health and Mental Hygeine.

Gomez, M., Bartlett, B., and Robert, J.S. (1979): Physiologic, responses to noise, Acoustic letters, 3, 96-97.

Hannunkari,I., Jarvinan, E., and Partnen, T. (1978): Work conditions and health of locomotive engineers, II Questionnaire study, mortality and disability. Scan, J.of Work, env, and health, 4, suppl.3, 15-38.

Ising, H., Guenitier, T. (1980 b): Health effects of traffic noise. International Archieves Occup. env. health, 947, 179-190.

Ising, H., Guenltior , T., Melter, H.U. (1980 a): Detection of mechanism of action of hypertensive action of industrial noise, 2.f, Abbeistmed, Arbeits, Prophylaxe, U. Ergomine, 301, 194-203.

Jensen, G., (1988): Paper presented at Inter-Noise-88; Noise News,17(6). 9-11

Jensen, (1961): Adverse effects of noise on iron and steel workers. of speech and Hearing dis;, Monograph Suppl. No.1.

Kapur, Y.P. (1968): Survey of personnel equipment and facilities available in speech and hearing hospitals in India.

Kerlinger, (1964): Foundations of behavioural research-educational and psychological inquiry, (Chapter-22) Helt, Rinehart and Winston Inc.

Kremerov, Abel, Fuller, Alberts (1984): Effect of noise on signal perception, Scand.Audio. 161-175.

Kryton, K.D. (1950): The effects of noise on man. J.of speech and Hear.Dis. Monograph Suppl.1.

Lang, W., (1988): Inter-noise 88, Noise News, 17(6),

Lanzelta, T., Giovanazzi, A., Furlanello T., (1979): Prospects for the use of dynamic angiography during work activity on subjects exposed to environmental noise; Minerva Cardioangiol 27(a), 559-566.

Larsen, B., (1939): Investigations of professional deafness in shipyard and machine factory labourer, Acta Oto.Laryng. , Stockholm, Suppl.36.

(1978)
Longmans Dictionary of contemporary English/- EH. Procter Paul, Longman Group Ltd., 391- 571.

Mahananda, P: (1972): Survey of noise and hearing patterns in an industry in Mysore, unpublished mater degree dissertation submitted to Mysore University.

McKelwin, W.B., (1933): Weavers deafness, J. of Laryng. 48, 607-608.

Mills, J.H., (1975): Noise and children; A review of literature, J.of Acou.sty. of Amer. 58, 767-779

NCERT (1962) survey of institutions of physically handicapped.

Peterson, E., Augustein, J.E., Hazetton, C.L. Hetrick, D. Levere, R.M., Daries, D.C. (1984): same cardio vascular effects of noise, J.of Acou.Res. 23(1), 35-62.

Rintelmann and Gasaway (1967): Survey of hearing conservation program in representative aero space industries, American industrial Hygeine Association, J. 28, 222-232.

Smith, R.C., Seitz, M., Borton, T, Kleinsten, R., Wilmotts, J., (1984): Modelling HTL of workers using path analysis and multiple regression technique, J. of Acou.Res. 24(2), 99-122.

Staab, Rintelmann, (1972): Status of warble tone in audiometers, J.of Aud.Commn. 26-32.

Suvarov, G.A., Densove, T., Ovakinov, V.G., Tavtin, U.K. (1979): Correlation between hearing loss and neuro vascular impairements in workers in relation to noise level-gig Truda i prof Zabolevaniia, 18-22.

Telford and Sawrey (1971): The acquisition and development of hearing, Ed. Menyuk, P. (Chapter-7), Page.200.

Temkin, J. (1933): Aural injury through noise and vibration, Mschr: Olvenhulle, 67; 257-299, 450-459; 527-553; 705-736; 823-834.

Tempest (1988): Noise handbook, Academic Press INc.

Times of India Directory (1984): Ed. Shanilal, Bombay,

Tottag and Bocci, G., (1967)- L'importaze del color dell'i' Ride nella valutazione della resis tenze dell' udi ot all affaticamen to Rev. Oto neuro oftalmol ar neurol Sud am. 42, 183-192.

Webster Universal dictionary (1970) Unabridged, International Ed. ed.by Wyld H.C., and Patridge, E.H., Routledge and Kegan Paul Ltd. 732.

Wolman, B.B. (1965): Handbook of clinical psychology, (Chapter 1) Pg.3, McGraw-Hill Inc.

Yaffe, C.D., Jones, H.T. (1961): Noise and hearing physical science publication No.850.

APPENDIX-A

Covering letter. AIISH
Mysore.

Respected sir,

The questionnaire enclosed is a part of the project which is a requirement for the part fulfilment of the first year masters degree in speech and hearing and hence your kind co-operation in completing the same and returning it at your earliest will be highly appreciated.

The questionnaire, necessiates that you tick where applicable; and in certain cases specifications are necessary. Additional space has been provided at the end of the questionnaire for your valuable additional comments.

The data that you will furnish will be treated with the highest degree of confidentiality and will be used only in studying the trends. A self addressed envelope has been included for your convenience.

Expecting your kind co-operation.

APPENDIX-B

Ouestionnaire for industrial employers.

1. Name of industry.
2. Type of products made.
3. No.of employees.
4. No.of shifts.
5. Duration of each shift.
6. Do the workers complain of noise and sound at their work area? YES/NO
7. Does the noise level allow easy communication with 3 feet distance. YES/NO
8. With present noise level at work area. Does one have to (tick where applicable)
   a) raise voice slightly to communicate
   b) shout to be heard to communicate
   c) impossible to communicate.
9. Is perceivable noise level mentioned in section '8' constrained to: (tick where applicable)
   a) portion of work area
   b) entire work area
10. What types of sounds are generated in the production process (tick where applicable)
    a) continuous noise (eg. air conditioner, compressor)
    b) Intermittent (eg. power hammer, forging etc)
    c) Impulse noise (eg. dynamite, cracker burst etc)

11. What is the percentage of workers exposed to

a) Continuous noise....% for . . . . hour/day

b) Intermittent noise ....% for . . . . hours/day

c) Impulse noise . . . % for . . . . hours/day.

12. For how many hours in a day is the sound level high.

13. Does the noise level of factory area disturbe the office area. YES/NO

14. Do the neighbours of the factory experience the noise of factory operation and complain. YES/NO

15. Is the management aware of noise, in work area and its hazard to health. YES/No

16. Is the management aware of the fact that continuous exposure to noise and sound might impair hearing. YES/NO

17. Do the workers complain of: (tick where applicable)

A) a) Fatigue due to noise or sound

b) Noise in the head

c) Ringing in the ear

d) Temporary hearing loss

e) Permanent hearing loss

f) Any other complaints

B) Have you ever had to pay compensation to your workers. YES/NO

18. a) At the time of staff recruitment do you have a hearing test as a part of the medical examination. YES/NO

b) If yes, who performs such an examination (specify the qualifications)

19. a) Does the management feel the need for hearing evaluations YES/NO

b) If yea, what do you feel, need be the frequency of such tests.

20. a) Have you ever had noise measurements performed in your factory. YES/NO

b) If yes, then who performed such measurements.

21. a) Are you aware of the existence of qualified personnel available to perform hearing evaluations and noise measurements. YES/NO

b) Are you willing to depute your staff for hearing conservation training. YES/NO

22. Are you willing to have periodic noise measurements made in your factory. YES/NO

If no, is it because of:

a) no funds or budget sanctions

b) do not feel the need for such measurements

c) unaware of the availability of technician to make such measurements

d) any other reason (specify).

23. what are the steps taken by your industry to control noise and reduce continuous exposure to noise (please specify).

24. Do the workers on their own use ear protective devices like cotton plugs, etc. YES/NO

25. Do you supply the workers ear protective devices YES/NO

If yes, please specify

a) types of devices

b) procurement sources

Space for additional comments.