ADDIS ABABA UNIVERSITY
SCHOOL OF PUBLIC HEALTH
DEPARTMENT OF PREVENTIVE MEDICINE

ASSESSMENT OF NOISE INDUCED HEARING LOSS AND ASSOCIATED FACTORS AMONG WORKERS IN AKAKI BASIC METAL INDUSTRY, ADDIS ABABA, ETHIOPIA

BY: ASHENAFI HAILU

A THESIS SUBMITION TO DEPARTMENT OF PUBLIC HEALTH, ADDIS ABABA UNIVERSITY IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR A MASTERS DEGREE IN PUBLIC HEALTH.

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Abbreviations

DALY – Daily adjusted life years

dB A - Decibel A weighted

ILO - International labor organization

KHz – Kilo hertz

Leq - a measure of noise that takes account of both the intensity of the sound and its duration

NIHL- Noise Induced Hearing Loss

NIOSH- National Institute for Occupational Safety and Health

ONIHL- Occupationally noise induced hearing loss

OSHAPEL - Occupational Safety and Health Administration permitted exposure level

PPE- Personal protective equipment

PPD – Personal protective device

PHPD – Personal hearing protective device

REL – Recommended exposure level

SPL – Sound pressure level

SPSS – Statistical package for social science

SNHL – Sensor neural hearing loss

WHO – World health organization

Abstract

Background: - Excessive occupational exposure to noise results in a well-recognized occupational hearing loss and now is taken as a global problem. Worldwide, approximately 600 million workers are exposed and 16% of disabling hearing loss in adults is attributed to occupational noise. However, in developing countries including Ethiopia there is no systematized recording and reporting of noise induced health problems.

Objectives: - To assess the magnitude and associated factors of noise induced hearing loss among Akaki basic metal Industry workers, between March and April, 2015.

Methodology: - Institutional based cross-sectional study was conducted in Akaki Basic metal Industry. A total of 244 eligible workers were included in study by using simple random sampling from workers` attendance sheet of respective sections. A pre-tested interviewing questionnaire, Environment noise survey, audiometric test were conducted. Epi-Info version 7 software was used for data entry and cleaning and then data exported to SPSS version 21 software for further analysis. Logistic regression model was used to identify factors associated with outcome variable.

Results:- Audiometric measurement revealed that the prevalence of noise induced hearing loss in Akaki Basic Metal Industry was 22% (95% CI 17- 27). Previous exposure of noise (AOR = 2.8, 95% CI: 1.032-7.923), service year 11-20 years (AOR = 2.3, 95% CI: 1.078- 6.262) and service years 21-30 years (AOR = 5.2, 95% CI: 2.317- 11.507) when compared with 1-10 years' service respectively were significantly associated with noise induced hearing loss. But, drinking alcohol (AOR= 1.6, 0.740-3.236) and being hypertensive (AOR = 1.7, CI: 0.800 – 3.776) respectively were not significantly associated with NIHL. The environmental noise level measurement was Mean (SD) of 89 $\pm$ 13.65 dB A**.**

Conclusion: - The prevalence of hearing loss in Akaki basic metal industry shows significant number with association of level of exposure, previously exposure to noise and duration of exposure. This shows as great effort is needed from administrative of the industry to provide appropriate hearing protective devices based on noise level of sections and change the behavior of workers towards using it, monitor noise level according to the country`s standard and installation of acoustics materials with in the industry to protect the health of workers from noise hazard. .

1. Introduction

1.1 Background:-

Occupational health is a science that concerns of the workers` health at their work place. Excessively exposure to occupational noise results in occupational hearing loss and now is taken as a global problem. To maintain social and economic development, a healthy productive worker is very critical or very important to increase the productivity of one country and for the growth of countries` economy. But, occupational environment is a place where many factors such as biological, physical, chemical, ergonomical or others exist that can predispose individuals to develop diseases. Recently, noise is become the most important physical hazard that is causing occupational hazard (1, 2).

Noise is excessive or unwanted sound which potentially results in annoyance and/or hearing loss whereas, Sound is a pressure variation (wave) that travels through air and is detected by the human ear (3).

Earsplitting or very severe sounds make the hair cells collapse and flatten temporarily, resulting in temporary deafness which is known as a temporary threshold shift (TTS) and may also be accompanied by a ringing sensation called tinnitus or hear ringing sounds that only heard by affected one. If the exposure become chronic it can cause permanent hearing loss that known as permanent threshold shift (PTS). Acoustic trauma that is related with exposure to explosive sounds can cause immediate permanent hearing loss (4).

Noise has a series of health effects, in addition to hearing impairment such as annoyance, hypertension, disturbance of psychosocial well-being, and psychiatric disorders (5). In work Environments like mining, manufacturing, music and the construction industry noise exposure is prevalent. Especially in construction workers one in twenty construction workers estimated to have occupational noise induced hearing loss(6, 7).

Noise is a prevalent exposure in many workplaces. Worldwide, 16% of hearing loss in adults is result of occupational noise, while it is the second most common self-reported occupational illness or disability in the US (8). In Finland, noise induced hearing loss is the most common

reported occupational disease and approximately 25% of workers report to have been exposed to sound levels of 80 dB(A) or more during work (9).

Recent statistics shows approximately 600 million workers are exposed to occupational noise worldwide (10). About 9% of the total workforces are continuously exposed to hazardous noise

levels in Sweden (11). In Pakistan, a major cause of hearing loss that is noise emitted from industries (12).

Among African countries, in Nigeria, study showed workers among steel rolling mill as they exposed to noise levels ranging from 49 to 93 dB A (13). Other study conducted in Tanzania Miner showed that the prevalence of NIHL was 47% with highest proportion of miners with NIHL (60%) were young age groups (14).

In Ethiopia, study conducted in Dire Dawa textile industry revealed that the prevalence of noise induced hearing loss 34% with higher noise level of in weaving section of mean $\pm$ SD 99.5 $\pm$ 3.2 dB A (15). Other study conducted on survey of noise level among metal and textile industries in Addis Ababa showed 26.2% of the working environments exceed 90dB A(16).

1.2 Statement of the problem

Global burden of disease studies estimate that exposure to occupational noise accounts for 16% of the disabling hearing loss in adults worldwide, ranging from 7–21% in the various sub regions(17). This range is explained partly by the lower prevalence of age-related hearing loss in developing countries due to lower life expectancy and younger populations and a rising prevalence of ONIHL in some developing countries as their manufacturing and construction sectors expand. In developed economies 7–10% of the burden of adult-onset hearing loss has been attributed to exposure to occupational noise(18). Occupational noise is the most common cause of noise-induced hearing loss in adults which is an irreversible damage of the cochlear hair cells of the inner ear.

In many developing countries, including Ethiopia, occupational diseases in particular and occupational safety and health issues in general haven`t, so far, been given attention due probably, to lack of awareness (19). Hence, the majority of the working conditions are unsafe and highly vulnerable to serious occupational hazards like noise that are lead to disability. In relation to this, the auditory and non-auditory effect of noise among workers becomes high which affects the productivity and economy. Information on occupational health and safety services is helpful in raising awareness at all level and making the problem of noise more visible to policy makers and managers. However, in Ethiopia there is no systematized recording and reporting of noise induced health problems. Data on noise at national level is also inadequate and even if it is present also it is not available at time wanted.

In Ethiopia, Ministry of labor and social affairs identified noise as occupational hazard in occupational health directive document of 2008 but there is no clear monitoring measure of noise; no material to measure, record and report the level and impact of noise and also competent professionals and laboratory setups at ministry of labor and social affairs enforce the regulations set by the ministry on noise. In addition this occupational health directives lacks clear procedure for compensation mechanism for NIHL and other effect of noise and no clear strategy developed to prevent the effect of noise at work places.

1.3 Rational of the study

At present many people are working under unsafe conditions, particularly in developing Countries, like Ethiopia where industries and other construction become highly expanded for the purpose of economic growth without considering safety of workers that pose disability such as hearing loss in the case of excessive noise and death in other cases of occupational hazards. So in the assessment made on occupational noise among workers is useful in the development of noise prevention strategy, initiates workers as they use hearing protection devices and also give clue for factory managers or policy makers as those hearing protective devices are essential for workers and to modify/ replace with modern technology, improve the engineering of industrial environment and machines and install acoustics materials so that noise induced hearing loss among workers due to occupational induced noise is minimized. In addition, it can also serve as base line information to undertake studies on similar settings.

2 Literature Review

2.1 Magnitude of occupational noise exposure level and its effect

Worldwide, 16% of the disabling hearing loss in adults (over 4 million DALYs) is attributed to occupational noise, ranging from 7% to 21% in the various sub regions. The effects of the exposure to occupational noise are larger for males than females in all sub regions and higher in the developing regions (17).

Long-term exposure to noise levels beyond 80 dB(A) carries an increased risk of hearing loss, which increases with the level and duration of noise exposure and ultimately this will lead to hearing impairment in some workers(20). WHO defined hearing impairment as a hearing loss of "at least 25 dB in the better hearing ear (average over the frequencies 0.5, 1, 2 and 4 kHz)" (21).

Since human conversation usually ranges between 0.5 to 2 KHz, a permanent threshold of more than 25 dB at frequencies between 0.5 to 2 kHz is considered to affect normal activities. Such level of hearing loss decreases the capacity to engage in conversation, in meetings or social activities, thus creating a significant barrier in establishing or maintaining emotional relationships and leading to isolation. Hearing loss due to chronic exposure to noise occurs by causing damage to the outer hair cells in the cochlea in the inner ear(22). The damage is permanent with no effective cure (23, 24). However, the risk of noise-induced hearing loss can be greatly minimized if noise exposure is reduced to below 80dBA(25).

Negative effects of noise on human beings are generally of a physiological and psychological nature. Hearing losses are the most common effects among the physiological ones. It is possible to classify the effects of noise on ears in three groups: acoustic trauma, temporary hearing losses and permanent hearing loss (26).

Noise also can related with blood pressure increases, heart beat accelerations, appearance of muscle reflexes, sleeping disorders may be considered among the other physiological effects. The psychological effects of noise are more common compared to the physiological ones and they can be seen in the forms of annoyance, stress, anger and concentration disorders as well as difficulties in resting and perception (27, 28).

2.2 Noise exposure level and its standards

In order to prevent the effect of noise there are different standards stipulated by OSHA PEL (since 1971–Present) as follows: - for noise level of <90 dB A, no time limit, for 90dBA, 8hrs, for 95dBA, 4hrs, for 100dBA, 2hrs, for 105 dB A 1hr, for 110 dB A 0.5hr (3).

In Ethiopia also exposure to noise with respected time or hours is sated with the Ethiopia occupational safety and health directives as the following: 90dBA for 8hrs, 92dBA for 6hrs, 95dBA for 4hrs, 97dB A for 3hrs, 100dB A for 2hrs, 102dB A for 1and ½ hrs, 105dBA for 1hr, 110dB A, for ½ hr 115 dB A for ¼ hr (29)

2.3 Prevalence and Factors related to noise induced hearing loss and utilization of hearing protection devices.

So some literatures indicate as occupational noise is highly prevalent in every corner of the world including developed countries. In many countries their standards of occupational noise exposure and the actual situations that is found in country is different. Workers` using of hearing protection device materials is also low as shown below.

A study carried on Noise induced hearing loss among major factories workers in Hong Kong, the prevalence of NIHL was 18.6% and risk factors were duration of occupational noise exposure, noise intensity, floor vibration and military experience. 36% of metal industry workers exposed to Leq (8hrs) 90dBA and above 54.1% of them were used HPD (30)

A cross-sectional study conducted in a metalworking company providing services in Rio de Janeiro, Brazil showed the prevalence of cases suggestive of NIHL was 15.9% (31).

A study conducted on Prevalence of occupational noise induced hearing loss on industrial workers in India showed the age group 36-40 was affected more when compared to other age groups. Chronic exposure to noise is common hazard in industrial workers that affect bilateral cochlea and causes high frequency SNHL with 4 kHz notch. 39% of industrial workers were exposed to noise level >87.3 dB A, for 8-12 h/day in textile and hard strip rolling mills(32).

Study conducted on Prevalence of permanent hearing threshold shift among workers of Indian iron and steel small and medium enterprises showed noise levels in punching/blanking, forging, molding, grinding, except gas cutting/welding, and tool room sections were more than the prescribed limits, i.e.,90 dB (A). The ear protection was found to be the least preferred or ever used PPE, and only 17% workers used it. The reasons stated for not using PPE: 40% did not feel uncomfortable, 10% are not used to wearing the same, 30% admitted to negligence, and around 25% said management did not provide PPE at work place (33).

An investigation done on hearing impairment among ginning workers in India, revealed that hearing impairement was significantly associated with the period of exposure to work place noise and noise dose ($P< 0.001$) (34).

The other study conducted on occupational deafness of workers in a Heavy engineering Industrial of west Bengal, India, revealed that among the total of 278 the prevalence of NIHL was 34.9 for who those exposed to above 90 dB A with $X^2 = 17.97$, df =2, p= 0.0001 of increasing exposure level and with duration of exposure $X^2 = 7.12$, df =2, p= 0.0284 (35)

A study conducted on occupational noise exposure and sensorineural hearing loss of among workers of steel rolling mill in Nigeria showed, the prevalence of NIHL was 28.2%. In finding NIHL was significantly associated with noise exposure level, increasing length of exposure and awareness of exposure to noise (13)

The other study conducted on Noise exposure, awareness, attitudes and use of hearing protection in a steel rolling mill in Nigeria, Noise measurement showed that 53% of factory workers were exposed to noise levels >85 dBA. There was a statistically significant ($P < 0.001$) relationship between the measured sound levels and awareness of noise exposure. 93% demonstrated awareness of the hazard of noise to hearing and 92% awareness of methods of prevention of NIHL but only 27% possessed hearing protectors and only 28% of these stated that they used them all the time (36).

A study conducted among Zimbabwe miners revealed that the prevalence of NIHL was 37% and with factors associated of age ($X^2 =30.99$ df=3 $p<0.01$) and work area ($X^2 =24.96$, df=5 $p<0.01$) (37).

A cross-sectional study done on the prevalence of noise induced hearing loss among gold miners in a mining company in Tanzania, revealed that previous occupational noise exposure was one of the risk factor for NIHL with $X^2 = 12$, $P < 0.05$ (14).

In Ethiopia, A cross-sectional study conducted in Dire-Dawa Textile Factory to assess the prevalence and risk factors for noise-induced hearing loss (NIHL) showed Audiometric test of 34% overall prevalence and with risk factors of increasing levels of noise exposure ($X^2= 174.1$, $p< 0.001$), years of exposure in the workplace ($X^2 = 45.9$, $p< 0.001$) with no employee reporting use of personal protective devices (15).

The other study conducted in Ethiopia was an assessment of noise measurement and survey carried out at four factories (two textiles and two metal processing) around Addis Ababa, revealed that 26.2% of working environments exceed 90dB(A) for eight hour exposure. Only 23.8% of workers under noisy occupational environments were wearing HPDs (16).

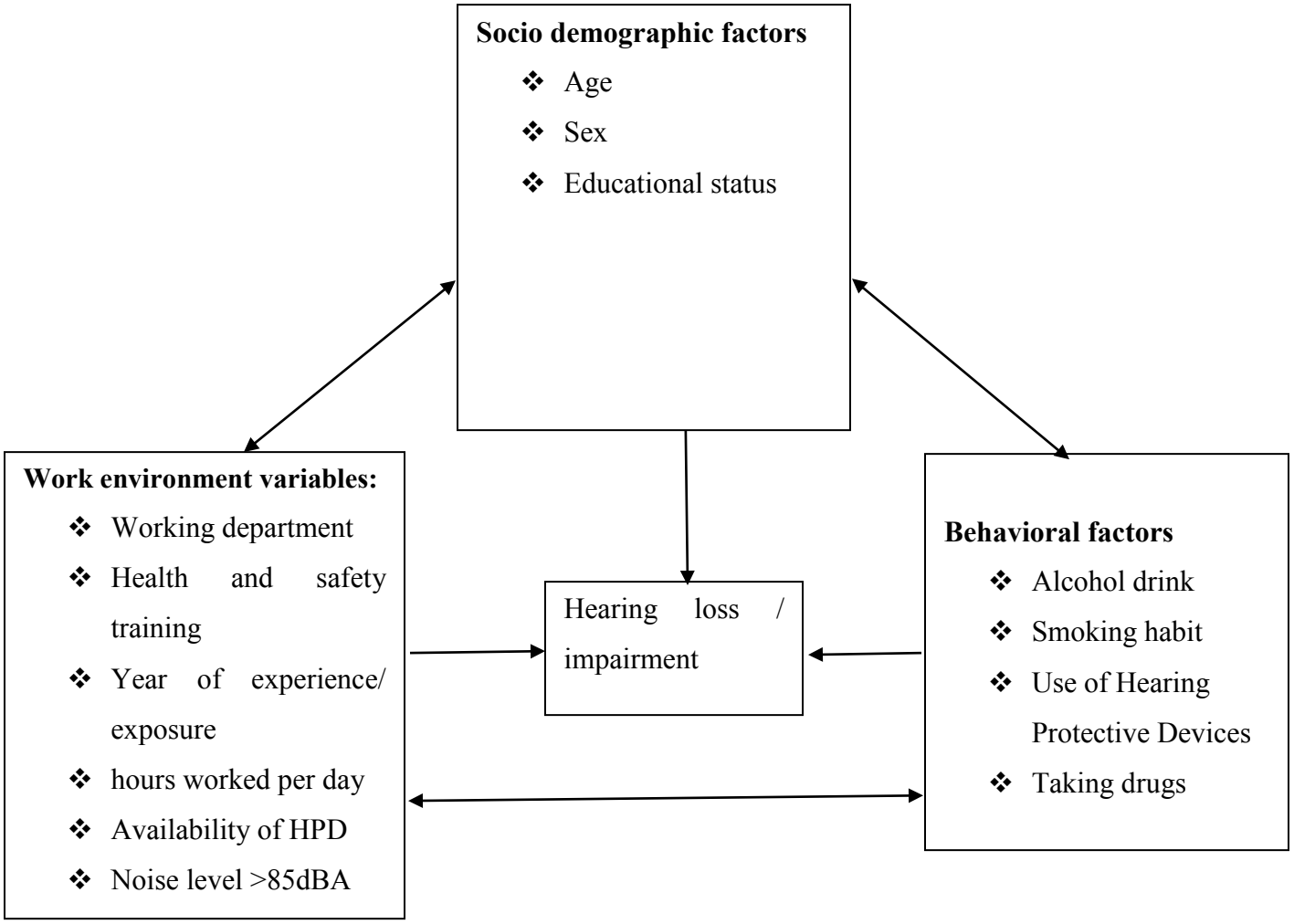
All hearing protection has to be labelled either on the device itself (ear muffs) or its packaging (ear plugs) and this label must show the appropriate grade. There have been some imports of substandard equipment which have not been graded and do not offer any practical protection (38)

Table 1: Noise Levels and types of protective hearing devices

Grade	Leq (8 hr) dBA	Types
1	86 - 91	Earmuffs or Earplugs
2	92 - 97	Earmuffs or Earplugs
3	98 - 103	Earmuffs
4	104- 109	Earmuffs
5	110 - 115	Earmuffs

In general better understanding of the noise level exist, prevalence and factors related to noise induced hearing loss is essential in the designing of effective noise prevention strategy so that the overall occupational health and safety services especially the noise prevention mechanisms can be improved and noise effect such as noise induced hearing loss and other non-auditory effects could be ultimately minimized and promote production opportunity.

Fig 1: shows conceptual frame work of NIHL developed from literatures those variables considered as Independent variables and related with the outcome variable.



3 Objectives

3.1 General objective

- To assess the magnitude and associated factors of Noise induced hearing loss among Akaki basic metal Industry workers, between March to April, 2015.

3.2 Specific objectives

- To Measure levels of noise in different departments in Akaki basic metal industry and compare it with the standards,
- To assess the prevalence of noise induced hearing loss among the workers of Akaki basic metal industry.
- To determine factors related to noise induced hearing loss among the workers of Akaki Basic Metal Industry.

4 Methods and Materials

4.1 Study design

Institutional based cross-sectional study design was conducted between Marchs to April 2015.

4.2 Study area:

A study was conducted on Akaki basic metal industry found in Akaki town. This industry is found 27KM away from Addis Ababa and one of industry included under Metals and engineering corporation which comprise 16 industries. Akaki basic industry was established in 1979 E. C as Akaki Hand Tools and Spare Parts Industry and started production 1983 E.C but in 2003 E.C it was incorporated under Metal and Engineering Corporation and its name also changed to Akaki basic metal industry. Now this industry contain over 700 workers with 500 permanent and 200 temporarily employees. Out of those workers over 459 workers are production staffs while the remaining are under the administrative staffs as data obtained from Akaki basic metal industry human resource department indicated.

Akaki basic metal industry produces different types of materials which are basic and essential in the construction of infrastructure in the country. Especially for those mega projects like Renascence dam gates, Ethiopia electric power authority materials, Manhole covering for telecommunication, rollers or grinder for different sugar factories in the country and other different products like cast iron melting, recycling of metals, hand tools materials, solid waste containers, gears for different huge machines, ferrous with large thickness which is used for construction of bridge under road construction and many more.

4.3 Study population

Those workers employed on production departments of Akaki basic metal industry.

4.4 Sample size determination

Sample size determination for objective-2

The sample size was determined using single population proportion formula by taking prevalence of NIHL 34% in Dire Dawa textile industry, Ethiopia (15).

$$n = \frac{(Z\alpha/2)^2 P(1-P)}{d^2} = \frac{(1.96)^2 * (0.34)(0.66)}{(0.05)^2} = 345$$

By including 10% non-response rate the total sample size was 379.

Where:

n : Sample size

P= prevalence of NIHL in Ethiopia

d^2= marginal error = 5%

Sample size calculation for objective- 3

Taking noise exposure year as independent factor to determine sample size because it was significantly associated with NIHL in study conducted on Dire Dawa textile industry (15).

Assumptions

To calculate first determine the value of P1 i. e % of outcome in unexposed group which was equal to P1 = c/c+d, 95% CI, 80% power, ratio (unexposed : exposed) = 1 , odds ratio = 2. And using Epi Info version7. A study conducted in Dire Dawa textile industry shows the numbers of unexposed and developed disease are (c) 178 and numbers of unexposed and not developed disease are (d) 375, so P1 = percent of outcome in unexposed group = c/c+d = 178/553 = 0.32, then by using Epi Info the total sample size was 300. But in order to make the study feasible and to measure all the sample size by audiometry the sample size for **objective 3** was used even by using correction formula since there was no generalization by this finding for all metal industry in the country and total population in the Akaki Basic metal Industry was 700 which was less than 10,000. So the sample size was

$Z\ \alpha_{/2}$: A standard Z score 1.96 corresponding to 95% confidence level.

$n_f = \frac{n}{1+ n/N}$, 379/ 1+379/700= 244

Where , nf = final sample size

N= total population

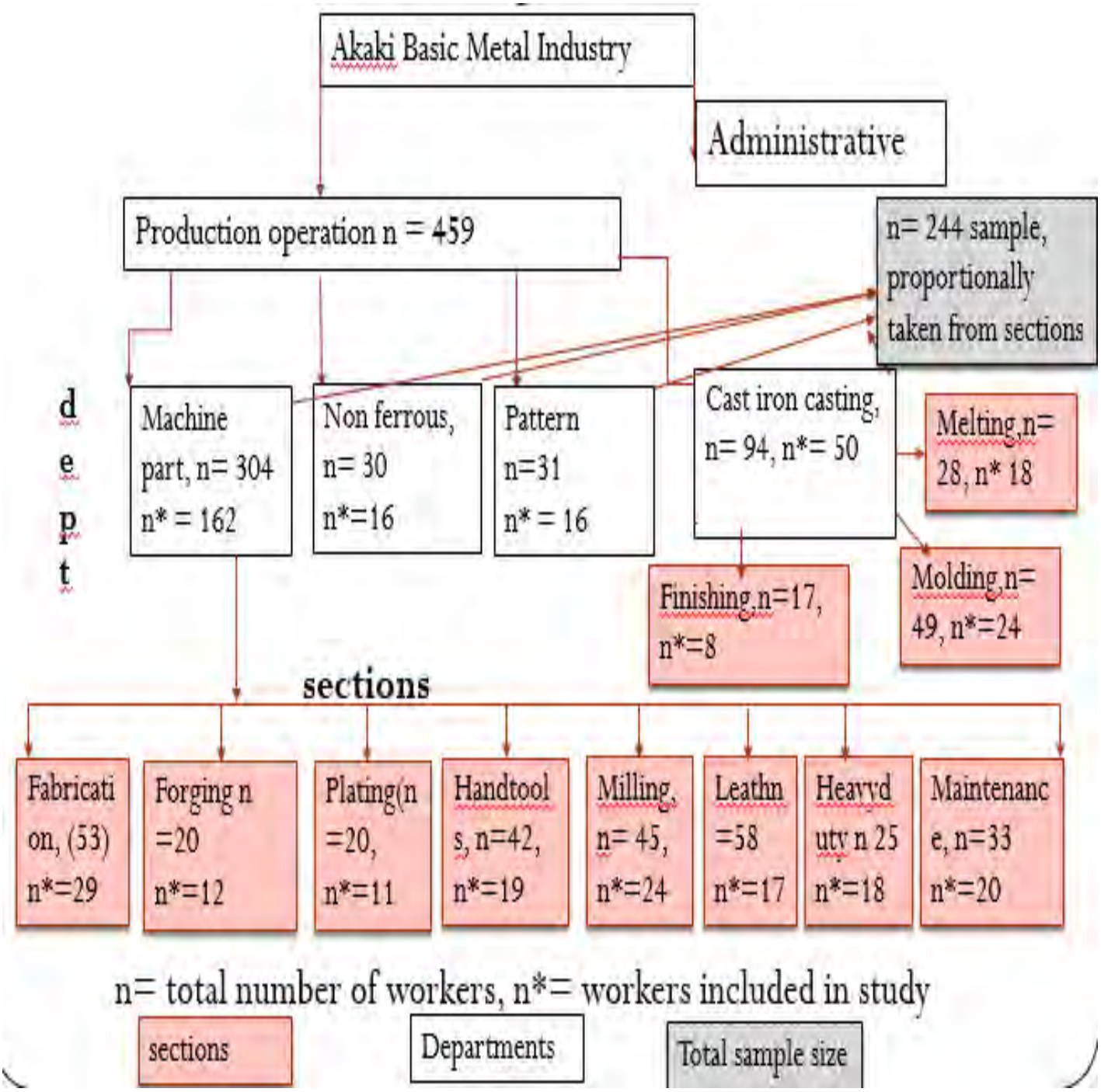
n= calculated sample size before correction

Therefore the final sample included in the study was **244** workers.

4.5 Sampling technique

Akaki basic metal industry was purposely selected industry in the consideration of time financial, material, human power constraints to account the whole 16 industries in the metal and engineering corporation. So the study sample that had been determined in the sample size determination technique was distributed in the departments of the industry according to their workers` number proportion and again the departments further classified in to sections proportionally to the departments. Then simple random sampling method was applied by using workers` attendance registrations as sampling frame. Finally, the study subjects were selected using simple random sampling technique from each sections as indicated in Figure 2.

Fig 2. Schematic presentation of sampling procedures of among Akaki basic metal industry workers, Addis Ababa, June, 2015



Inclusion and Exclusion criteria's

Inclusion criteria: Workers at least one year and above service in production site were included irrespective of sex and age.

Exclusion criteria: workers who have history of ruptured tympanic membrane, active ear infection identified during otoscopic examination, known hearing problem and workers service less than one year were excluded.

4.6 Data collection

A data collection team carried out three types of data collection activities including physical diagnosis and audiometry, interview questionnaire based survey and environmental noise survey.

4.6.1 Audiometric measurement

Pure tone audiometric records were collected by a trained audiometric technician using a manual recording audiometer Model 9D Belton Audiometer. The audiometer was calibrated at the outset of the study and recalibrated regularly using biological standards. Biological standards are healthy individuals on which the instrument is calibrated under the same environmental conditions or obtained by testing the hearing sensitivity of young, healthy adults and averaging the sound level at specific frequencies at which the tones were barely perceptible (39). All audiometric tests were carried out in a quiet room (the background of test room was minimum 36 dB A and maximum 40 dB A) outside the factory before the workers entered their work shift to avoid the effects of temporary threshold shifts, due to recent noise exposure inside the factory. Subjects were considered as impaired when their hearing threshold level exceeded or equal to 30 dB A (38). Employees were advised of a planned audiometric test, so that they can have a 'quiet time' of ideally 16 hours before audiometric test (40). The testing frequencies were at 250Hz, 500Hz, 1000Hz, 2000Hz, 3000Hz, 4000Hz and 8000Hz. But the cut point for reference was 4000Hz, since the deficits due to nose-induced hearing loss are confined to this frequency and the criteria adopted for notification is that the threshold at 4KHz is at least 30dB Hearing Loss (HL) and is at least 15dB worse than the 2KHz threshold as indicated in the following figure 3 (38).

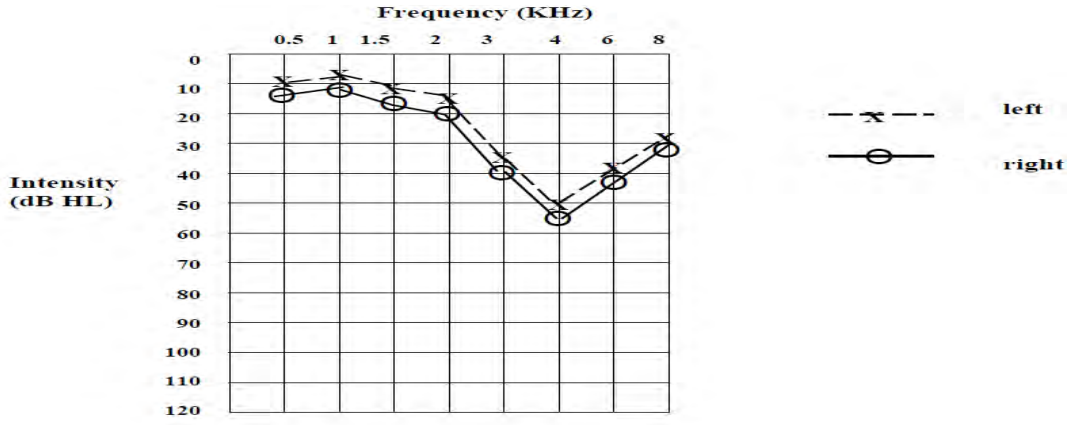


Figure 3. The shape of the Noise induced hearing loss notch.

Data collector was audiometric technician for audiometric reading and physician to do physical diagnosis and noise induced hearing loss was identified with physician trained on this area or otolaryngologist.

4.6.2 Questionnaire survey

A standard questionnaire and other adopted questionnaire from the same study was used for measuring occupational hearing capacity in the interview. The questionnaire was designed to obtain a complete history relevant to hearing, including demographic data, duration of occupational exposure, history of auditory problems, drug use behaviors, and pattern of hearing protection devices use. The questionnaire was be pre-tested to identify potential problem areas; unanticipated interpretations and cultural objections to any of questions. Hence, 5 % of sample population was be pre tested in FDRE Metal fabrication industry found in Addis Ababa which was out of the study industry.

The interviews/data collection was conducted by two environmental health technician one nurse students from Defense College of health science who was trained for three days in the use of the data collection tools. One Environmental health professional and a public health professional that had experience in research work were supervised the data collection process.

4.6.3 Environmental noise measurement survey

Noise levels was measured in work stations corresponding to each sampled workers position or by position the microphone in the monitored worker's hearing zone which OSHA defines the hearing zone as a 2-feet-wide sphere surrounding the head using a digital sound level meter model 840029 Taiwan(41). It was perfect for OSHA requirements which meets IEC 61672 class

2 and ANSI S 1.4 type 2 frequency and time weighting specifications, DIN 45633 and JIS 1502 whose frequency weighting selector A and C which were conformity to standards. It has also time weighting (SLOW and FAST) which are dynamic characteristic modes. In this study the FAST was selected to capture the peak noise level which may be occurred intermittently. Moreover, the sound level meter and noise dosimeter were calibrated at 94.0 dB before each measurement was conducted. Since the characteristic A weighting is simulated as at the Human ear listening response, it is recommended to be used for environmental noise level measurements (39). Measuring considerations like keeping the microphone dry, avoiding serious vibrations during measurement, keeping conditions of temperature and humidity were properly kept (41). Noise level measurements were made at each selected working site on three different days and the averages of these were taken. Every departments` sections of Basic metal industry were considered. For a working site, measurement was done two times; one in the morning and one in the afternoon for consecutive three days for each sections. These measurements were averaged and taken as the noise level measurement of the sections. Similarly personal noise dosimeter also assessed by using (model 407355 Taiwan) which was designed to test noise exposure in accordance with OSHA and ISO as indicated in figure 3 from three sections.

Figure 4 Indicates how personal dosimeter was measured in Akaki basic metal industry workers, Addis Ababa, June, 2015.

Finally the averages of those three day measurements was represent the noise level of that specific working site. The average of noise measured by Sound level meter and dosimeter was calculated using the logarithmic formula (39).

$$\text{Average } L_P = 10 \times \log_{10} \left(\frac{1}{n} \sum_{1}^{n} 10^{\frac{L P_n}{10}} \right)$$

Where:-

Lp – sound pressure level

n – Number of individual reading

A-weighted Sound Level Calculation in noise dosimeter calculation

$$L_A = 16.61 \log_{10} \frac{D}{12.5t} + 90$$

L_A = the continuous equivalent A-weighted sound level in decibels for the time period sampled

D = dosimeter readout in percent noise dose

t = the sampling time in hours

On the measurement occupational noise experts of occupational health and safety with the qualification bachelor in occupational health and safety were included with the principal investigator.

4.6.4 Work Environment noise observation

Using work environment observational check list the environmental factors that were related with noise induced hearing loss was identified. Those factors were noise level exceeds 85 dB A, difficulty to communication in the work place, sound level meter or an octave band analyzer and records being kept, isolation of noisy machinery, engineering control of excessive noise, administrative control, ongoing preventive health program and availability of HPD, Periodic audiometric checkup for employees exposed to noise above 85 dB A , exposure of workers to toxic chemicals and excessive heat was checked.

4.7 Data quality management

Every day the completed questionnaires handled to the supervisors. After checking for consistency and completeness, the supervisors were submit the filled questionnaires to the principal investigator. The collected data was double entered by principal investigator to verify whether the data was properly entered or not by data clerk. In questionnaire based data collection the English version was converted to Amharic version and back to English to keep its consistency. In terms of noise measurement the material was calibrated with experts and set with 94.0 dB and checked whether the material was functional according to the standard or not.The audiometric measurement was conducted with professionals and which was calibrated biologically (healthy individuals on which the instrument was calibrated under the same environmental conditions).

4.8 Study variables

4.8.1 Dependent variables

- Hearing loss (≥30dB A at 4KHz audiometric result)

4.8.2 Independent variables

Socio demographic factors

- ❖ Age
- ❖ Sex
- ❖ Year of experience
- ❖ Educational status
- ❖ Profession / job category

Work environment variables:

- ❖ Working department
- ❖ Health and safety training
- ❖ Availability of HPD
- ❖ Noise level >85 dBA

Behavioral factors

- ❖ Alcohol drink
- ❖ Smoking habit
- ❖ Use of personal protective device

4.9 Operational definitions

Noise; is excessive or unwanted sound which potentially results in annoyance and/or hearing loss (3).

Continuous noise: noise with negligibly fluctuations of level within the period of observation
Impulsive noise: a type of noise characterized by a sharp rise and rapid decay in sound levels and is less than 1 second in duration. It also refers to impact noise
Intermittent noise: noise levels that are interrupted by intervals of relatively low sound levels.
Annoying: to be disturbed especially by continued or repeated exposure to noise.

Noise-induced hearing loss (NIHL):- is an inner ear loss, caused mainly by damage to hair cells in certain regions of the cochlea, resulting in sensor neural hearing loss. Or NIHL is hearing impairment of high frequencies especially at 4 KHz (when the notch is formed or greater than 30 dBA at 4KHz but become recovered at 8 KHz) ().
Hazard: is anything that has a potential to cause damage.

Safety: means the state for which the risks are judged to be acceptable.

Production departments:- are departments which include casting iron, machine part, non ferrous.

4.10 Data analysis procedures

Data was entered using Epinfo version 7, and analyzed using SPSS statistical package, version 21. Descriptive statistics of the collected data were done for most variables in the study using standard statistical parameters: percentages, mean and standard deviations. Cross tab, Crude odds ratios with 95 % confidence interval was used to measure the association of dependent and independent variables. Adjusted odds ratios with 95% confidence intervals was calculated for each of independent variables that were significant on bivariate analysis at $P < 0.05$ were included in multivariate analysis in order to control the confounders and to show the strength of association of predictive factors. For the Environmental measurement the logarithmic of the results was analyzed and compared with the standards. Respective mean, standard deviation of sections were calculated.

4.11 Ethical considerations

All study participants were briefed about the purpose of the study including how the study was beneficial to them and for the whole country. They were told that there was not be any invasive procedures involved. Great emphasis was given in explaining the fact that no individual participant was obliged to participate in the study. The decision to participate or not was fully based on his/her willingness. An informed written consent was prepared so that each participant was able to decide whether to participate or not after full understanding of the purpose of the study the right to refuse to participate, and that the responses given was confidential to anyone else. After the investigation was done those employees identified as positive with NIHL, by discussing with the clinic, and Industry`s manager they are on process to refer them to Army Force General Hospital for further investigation and treatment. The proposal was approved by a letter of clearance from Addis Ababa University School of public health. The clearance paper and a letter asking for cooperation together with the proposal was submitted to the Akaki Basic metal Industry so that the investigator could proceed with the data collection process only after permission was given.

4.12 Dissemination of result

The findings of this study will be disseminated to the industry or Akaki basic metal industry including Addis Ababa university school of public health. This will be done through submission of reports and presenting findings at appropriate seminars, workshops and conferences. Besides publication of the study findings on the local /international journal will be considered.

5 Results

From a total of 459 production workers in the factory, 244 workers were included in the study. Almost all of those workers above one year service were included under the study according to the inclusion criteria. But about 195 workers were exclude either below one year service or known hearing problems. There was no non-response found during the data collection.

5.1 Socio demographic characteristics of the Workers

The mean (SD) age of workers was 34 (10.9) and about 200 (82.0%) of the workers were males.
The dominant religion in the study participants was Orthodox 186 (76.2 %) followed by protestant 36 (14.8%).
Most of educational level of the study participants were Technical/ college diploma 148 (60.7%) followed by complete elementary school 39 (16 %).
Regarding to profession or job category 16 (6.6%) mechanic, 30 (12.3%) welder and grinder, 57 (23.4 %) operator, 32 (13.1%) mold maker, 47 (19.3%) machinist 12 (4.9%) electrician 25 (10.2%) melt maker, 9 (3.7%) finisher and 16 (6.6%) were pattern maker (Table 2).

Table 2: Socio demographic characteristics of respondents of Akaki basic metal industry workers, June, 2015

Characteristics	Number n=244	Percent
Sex		
Male	200	82
Female	44	18
Age group		
<30	119	48.8
30- 39	39	16
40 – 49	55	22.5
> 50	31	12.7
Educational status		
Illiterate	4	1.6
Read and write	6	2.5
Primary (1-8)	39	16
Secondary (9-12)	37	15.2
Technical/college diploma	148	60.7
Degree	10	4.1
Marital status		
Single	127	52
Married	109	44.7
Divorced	8	3.3
Exposure in years		
1-10	152	62.3
11- 20	38	15.6
21- 30	54	22.1
Religion Orthodox	186	76.2
Muslim	15	6.1
Protestant	36	14.8
Catholic	6	2.5
Other	1	.4

5.2 Personal history and work related information

Among the study participants 241 (98.8%) of the workers have no additional work which exposed them other noise sources out of Akaki basic metal industry. But, 34 (13.9%) workers were previously exposed to noisy works such as welding and grinding 14 (5.7), Textile industry 8 (3.3%), Rail way 6 (2.5%), Wood work 3 (1.2%) and operator 3 (1.2%). The other factor that workers previously exposed to noise was being military personal 18 (7.4%) of those exposed to battle war and explosion of heavy weapons. Regarding of previous of hearing test only 7 (2.9%) had hearing test prior to the present job, almost there is no pre-employment hearing test only 29 (11.9%) of them pretested but 215 (88.1%) of the workers had not tested. In terms of noise emitted from their section 196 (80.3%) of the workers feel as the current noise level in their section is hazardous and trouble their hearing capacity.

In this assessment, the previous experience of disease conditions of workers was assessed which showed as 21 (8.6%) ever had ear discharge or infection, 45(18.4%) had cold in last fortnight prior to test, 25 (10.2%) ever had head injury and also other illness like bacterial meningitis 3(1.2%), mumps or measles 15 (6.1%), rheumatic fever 25 (10.2%) , epilepsy 5 (2%), Tb treated 5 (2%), Ear, Nose and Throat problems 13 (5.3%). Whereas 49 (20.1%) do have ear problem, 42 (17.2%) do feel hearing problem, 42 (17.2%) hearing difference of the left and right ears during test. Regarding to tinnitus, 42 (17.2%) have ringing or trouble noise in their ear or head. In terms of medication, 4 (1.6%) taking medication now or regularly out of those 1 (0.4%) anti retro viral drug, 1 (0.4%) anti-hypertensive drugs, 2 (0.8%) anti-diabetic drugs.

Table 3: Personal history and work related characteristics of respondents of Akaki basic metal industry workers, June, 2015

Characteristics	Frequencies n= 244	Percent %
Have additional noisy work		
Yes	3	1.2
No	241	98.8
Previous work in other noisy area		
Yes	34	13.9
No	210	86.1
Ever been in military service		
Yes	38	15.6
No	206	84.4
If military, ever exposed to gun shot or explosion at battle war (n= 38)		
Yes	18	47
No	20	53
Had pre-employment hearing test		
Yes	29	11.9
No	215	88.1
Feeling section`s noise level hazardous/ trouble to their ear		
Yes	196	80.3
No	48	19.7
Ever had ear discharge, trauma or infection	21	8.6
Yes	223	91.4
No		
Ever had head injury		
Yes	25	10.2
No	219	89.8
Now hearing problem		
Yes	42	17.2
No	202	82.8
Hearing difference of right and left ear		
Yes	42	17.2
No	202	82.8
Taking regular medication		
Yes	4	1.6
No	240	98.4

5.3 Behavioral characteristics

The data showed that, 126 (51.6%) and 11(4.5%) were drink alcohol and smoke cigarette respectively, whereas 29 (11.9%) of the workers participate in night club or band. Regarding to use of hearing protective devices 148 (60.7%) of them use it, out of those 3 (1.2%) used ear muffs, 145(59.4%) used ear plug and 1 (0.4%) of them used other. In terms of frequency of using hearing protective devices 16.6 (6.6%), always used, 113 (46.3%) used sometimes and 20 (8.2%) of the workers used rarely. Out of those workers not used hearing protective devices 96 (39.3%), 63 (65.6%) of not used because hearing protective devices was not available, 14(14.6%) of workers didn`t know nothing about hearing protective devices, 2 (2.1%) of them didn`t believe on its use, 14(14.6%) of them didn`t use because of discomfort and 2 (2.1%) because of other reason. In case of safety training or education, 145(59.4%) of them get safety training.

In other case, when the duration of training considered of last training or education those who took training, 106 (43.4%) were for last 1-3 years, 25 (10.2%) were for last 4- 6 years and 11 (4.5%) of them were taken for last 7-9 years. Related with noise related health effect or noise hazard effect only 69 (28.3%) of the workers report as it is included in safety training but 175 (71.7%) of the workers didn`t learn the effect of noise on their health at their work place.

5.4 Noise level measurements of different departments

The noise level in different departments` sections of the industry was measured using sound level measurement and personal dosimeter of over all **Mean (SD) of 89 ± 13.65**. The respective sections of departments were measured at different point source of emissions using sound level measurement. The measurement showed that in some Machine department`s sections like fabrication noise level which was extreme and measured up to 120dB A during hammering of metals with impulsive noise type and grinding of metals which emitted maximum of 108 dB A with intermittent type of noise. In Forging sections creaming machine emitted maximum of 102 dB A of continuous noise, Tumbling machine maximum of 104dB A with Intermittent noise and Hammering machine maximum of 103dB A with impulsive type of noise. From Die making and Hand tools sections, there were machines known as Power axon and Shearing machine which emitted maximum of 100 dB A and 101 dB A respectively with intermittent type of noises. In molding sections of cast iron casting department a machine known as Pang borne emitted a

maximum of 94 dB A with continuous type of noise. Almost all of the rest machines emitted continuous type of noise with respective magnitude as indicated in **Table (4)**

Table 4 **The noise level measurements of different departments measured by sound level measurement in Akaki basic metal industry, Addis Ababa, June, 2015**

Locations	Measurement in dB (A) Reading 1	Reading 2	Reading 3	Average noise level in dB (A)
1. Machine part				
1.1. Fabrication	110	112	114	112
1.2. Forging	103	100	101	101.3
1.3.Leath machine	80	85	79	82.2
1.4.Milling	75	80	78	78
1.5.Heavy duty	80	90	85	87
1.6. Maintenance	74	72	72	73
1.7.Plating	70	74	71	72
1.8. Die making	90.5	96	91	93
1.9. Hand tools	90	96	94	94
2. Cast iron casting				
2.1.Molding	86	89	87	87.5
2.2.Melting	74	66	70	70
2.3.Finishing	89	99	91.2	94
3. Pattern	102	95	91	98
4. Non ferrous	70	71	70	70.3

From the table above it indicates as some of the section above the standards or 90dB A for 8 hrs leq and others below. Especially in Nonferrous department the average noise level low but only one machine which is known as shake out machine which produces up to 106.6 dB A. in terms of dosimeter calculation three section were taken as sample model two highly noise sections and one moderate sections sampled for different times from three different workers. Since 8hrs full time were not measured only the respective time of the result was indicated from each respective sections.

The result of those dosimeter reading was calculated using the method indicated above or dosimeter calculation. Those results were

1. Fabrication 108 dB A within 2:08hrs grinding machine or 336.6% at 2:08hrs
2. Forging 102 dB A within 5:01hrs , tumbling machine or 332.5% at 5:01 hrs
3. Heavy duty 92 dB A within 6:18hrs or 108.4% at 6:18 hrs

5.5 Prevalence of noise induced hearing loss among Akaki basic metal industry

5.5.1 Prevalence of NIHL in terms of socio demographic characteristics

The prevalence of noise induced hearing loss was assessed by using audiometric test at 4000 Hz notch indicated on above **figure 2**. This finding showed that the prevalence of NIHL was 54 (22%). When the prevalence of NIHL considered among age group, there were 8 (3.3%) among < 30 years, 7 (2.9%) 30-39 years, 21 (8.6%) 40- 49 years and 18 (7.4%) > 50 years of age groups. Regarding to their service year or year of exposure, 17 (7%) of 1-10 years' service, 11 (4.51%) of 11-20 years` service and 26 (10.7%) of 21-30 years` service developed NIHL. Among sex 53 (21.72%) of males and 1 (0.41%) of female were developed the noise induced hearing loss. By their profession 7 (2.87%) of welder and grinder, 19 (7.79%) of operator, 6 (2.46%) of melt maker 4 (1.64%) of finisher, 6 (2.46%) of machinist, 5 (2.05%) of mechanic and 5 (2.05%) of mold maker were developed NIHL.

Table 5 Prevalence of noise induced hearing loss by socio demographic characteristics among Akaki basic metal industry workers, Addis Ababa, June, 2015

Characteristics	Frequency n= 2444		Prevalence of NIHL (%)	$X^{2,}$ (df)	P value
	Yes =54	No=190	=22		
Age group in years					
<30	8	111	3.1	48.239 (3)	0.001
30-39	7	32	2.9		
40-49	21	34	8.6		
>50	18	13	7.4		
Service year					
1- 10 years	17	135	7	32.804 (2)	0.001
11-20 years	11	27	4.5		
21- 30 years	26	28	10.7		
Sex					
Male	53	147	21.72	12.284 (1)	0.001
Female	1	43	0.41		

df – degree of freedom

In other cases in terms of working department the prevalence of NIHL was 35 (14.34%) among Machine part, 12 (4.92%) among Cast iron casting, 3 (1.29%) among Pattern department and 4 (1.64%) Nonferrous department. Regarding to the HPD, among non 96 HPD users 19 (7.79%) of them were developed NIHL and also among 148 HPD users 35 (14.34%) were developed NIHL. Where as in terms safety education total of 99 of workers who didn`t take safety education 21(8.61%) developed NIHL and out of 145 who did take safety education 33 (13.12%) developed NIHL.

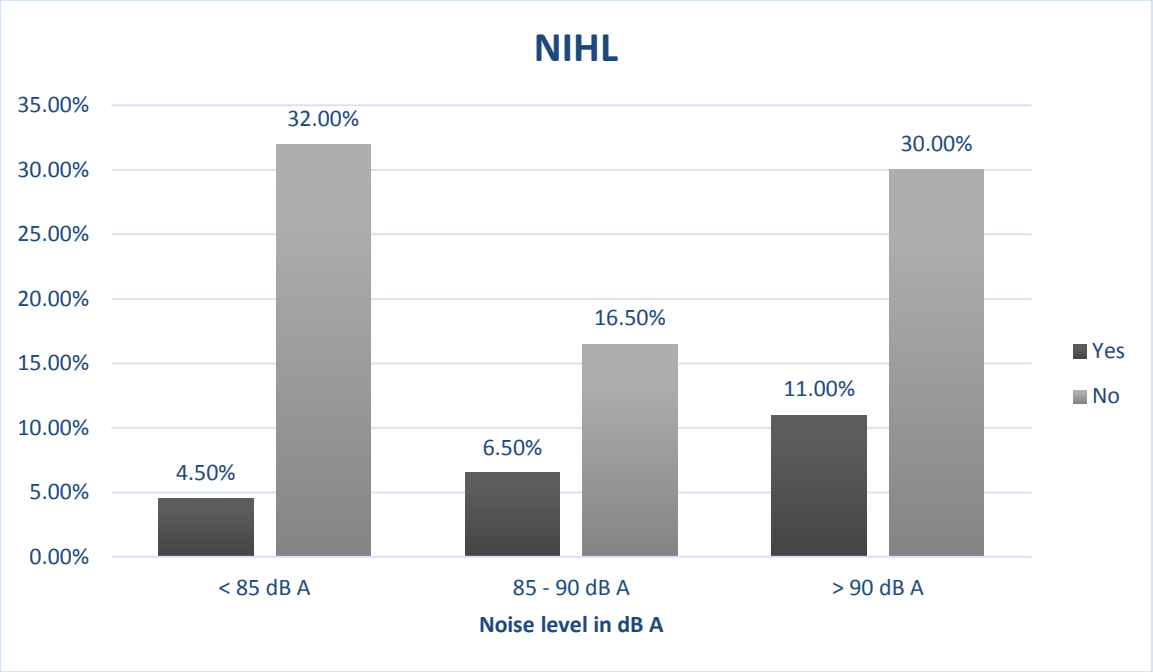


Fig 5 The prevalence of NIHL among workers of Akaki basic metal industry, by Noise level, June, 2015

5.6 Factors related to the prevalence of noise induced hearing loss

5.6.1 Socio demographic, personal history and environmental related and behavioral factors

5. 6.1.1 Socio demographic status

Among socio economic factors age, sex, service year were included in analysis.

The age of the worker was significantly associated with NIHL. Workers who were between 30 to 39 age group were at high risk with COR 3 (95% CI 1.023 – 9.009) NIHL, 40 – 49 age groups with high risk of COR 8 (3.483 – 21.087) and age groups of > 50 years COR 19 (95% CI 6.985

– 52.841) when compared with age of < 30 years age group. Regarding to sex being male was 15 (2.083- 115.399) higher compared to females.

Service year was also significantly associated with NIHL with COR 3 (95% CI 1.364- 7. 674) 11- 20 service years and COR 7 (95% CI 3.538- 15. 369) of 21- 30 service years respectively when compared with 1- 10 service years in bivariate analysis.

5.6.1.2. Work environment, personal history and behavioral information

The selected work environments like job type being finisher and operator were high risk of NIHL rather than other job categories when compared with machinists who worked on Leath machines which noise emission was law with COR 5 (1.138 – 26.257) and COR 3.4 (1.234 – 9.460) respectively in bivariate analysis. Other factor which was previously work in noise environment also significantly associated with NIHL with the COR 2.975 (95% CI 1.384 – 6.393) and noise levels COR 3 (1.353 – 7.435) and 2.5 (1.150 – 5.399) of 85- 90 dB A and >90 dB A when compared with less than 85 dB A were significantly associated with noise induced hearing loss. But other environmental factors like department or being working in machine part with COR 0.65 (95% CI 0.191 – 2.260), cast iron casting with COR 0.66 (95% CI 0.172 – 2.520) and being pattern department COR 0.338 (95% CI 0.062 – 1.831) were not significantly associated with NIHL when it was compared to Nonferrous department, where average noise level is 70 dB A. Those individuals who take regular medication like anti TB, for diabetic, for hypertension, anti-retroviral drugs was significantly associated with NIHL by COR 11 (95% CI 1.132- 109.152).

Table 6 Bivariate analysis of personal history on NIHL among Akaki Basic metal industry workers, June, 2015

Characteristics	Noise Induced Hearing Loss (NIHL) Yes	No	Crude OR (95% CI)
Military service			
Yes	10	28	1.315 (0.594 – 2.912)
No	44	162	1
Have you had a cold in the last fortnight?			
Yes	10	35	1 (0.462 – 2.192)
No	44	155	1
Ever had head injury			
Yes	6	48	1.1 (0.426 – 2.974)
No	19	171	1
Ever had ear discharge or infection			
Yes	5	16	1.125 (0.426 – 2.974)
No	49	174	1
Feel have hearing problem			
Yes	14	28	2.1 (0.977 – 4.198)
No	40	162	1
Having tinnitus/ ringing in the ear			
Yes	10	32	1.12 (0.512 – 2.46)
No	44	158	1

From the table above personal factors like being military service, had a cold in the last fortnight, ever had head injury or ear discharge or infection, have hearing problem or tinnitus were not significantly associated with NIHL.

Among selected behavioral factors drinking alcohol was significantly associated with NIHL with COR 1.9 (95 % CI 1.037 – 3.547), whereas smoking cigarette 0.34 (0.043 -2.714), participating in night club COR 0.53 (0.175 – 1.589) and using Hearing protective devices or HPD COR 1.25 (0.669 – 2.355) were not significantly associated with NIHL.

5.6.2 Multivariate analysis of Predictive factors

Those variables like age groups, drinking alcohol, service year, and previous noise exposure, diastolic blood pressure, regularly taking medications for chronic diseases like diabetic, HIV, Hypertension, noise level and sex significant at bivariate analysis were included in the model as indicated in table 7. But in the case of Age and service year since they have collinearity or age and service year were highly correlated the model become affected. Because of this they cannot be included simultaneously in one model. Their collinearity evidence was checked by Kendalls tau-b and Spearman rho test which were result in correlation coefficient of 0.774 with significance at 0.001 and r= 0.835 with significance of 0.001respectively. Because of this age and service year variables were not included in the same model and age was excluded from model from objective point of view. The result of multivariate analysis indicated that being male sex, high service year, previously exposed to noise were significantly associated with NIHL.

Table 7 Summary of the logistic regression analysis model of the relative effect of Socio-

Demographic, environmental and behavioral factors on the magnitude of NIHL among Akaki Basic Metal Industry workers, June, 2015

Characteristics	Noise Induced Hearing Loss		Crude OR (95% CI)	Adjust OR (95% CI)
	Yes	No		
Sex				
Male	53	147	15 (2.083-115.399)*	8 (1.106-67.022)**
Female	1	43	1	1
Service year				
1- 10	17	135	1	1
11- 20	11	27	3.2 (1.364– 7.674)*	2.5 (1.001- 6.141)**
21- 30	26	28	7.4 (3.538 –15.369)*	5 (2.280 -11.576)**
Previously work in noisy area				
Yes	14	20	3 (1.384-6.393)*	2.8(1.032-7.923)**
No	40	170	1	1
Diastolic blood pressurin mmHg				
60 – 89	23	31	1	1
90 – 99	31	159	3.8 (1.962 – 7.382)*	1.7 (0.800-3.776)
History of taking medication				
Yes	3	1	11 (1.132-109.152)*	8 (0.407-176.122)
No	51	189	1	1
Drinking alcohol				
Yes	32	82	1.9 (1.037-3.540)*	1.6 (0.740 – 3.236)
No	22	108	1	1
Noise level				
> 85 dB A	11	78	1	1
85 – 90 dB A	17	38	3 (1.33-7.435)*	2 (0.785- 5.347)
> 90 dB A	26	74	2.5 (1.150- 5.399)*	1.2 (0.436 – 2.679)

*** Significant at P < 0.05 bivariate analysis** **** Significant at P < 0.05 multivariate analysis**

5.7 Work Environment observation

5.7.1 General work Environment

Generally, the work environment found in Akaki basic metal industry, shows as all work surfaces were kept dry or appropriate means taken to assure the surfaces were slip resistant. Machine part and pattern departments where relatively clean when compared to Nonferrous and cast iron casting departments because in these sections there was dust relative high temperature because of the work nature it cannot be free from dust formation and temperature especially in molding and melting as well as finishing sections. Spilled materials or liquids especially found in plating section flows simply throughout the room water drain lines and floor of the section. In terms of debris and waste especially chips generated from machine part department were stored relatively safe and removed from work site but the combustible dust in cast iron casting and nonferrous departments was not cleaned up with a vacuum system to prevent the dust going to suspension. All work areas were adequately illuminated and the minimum number of toilets and washing facilities were provided.

5.7.2 Noise related observation

Regarding to the noise related observation even if there were many work areas emitted high amount of noise level in different sections as indicated in result part, no noise levels were measured using a sound level measurement or an octave band analyzer and noise records were not being kept.

In isolating of noisy machinery or sections from the rest operation, no activities were done. In machine department, fabrication section was found with in other sections like Hand tools, heavy duty, maintenance, leath, die making, chrome plating and milling. Those sections emitted low amount of noise even if it was based on the type of metal processed and type of processes. But those all sections` workers were equally exposed to noise emitted from fabrication. The worse situation in this department was that workers in fabrication section wear HPD which was ear plug because the section was considered as noisy but the others sections found nearby didn`t get ear plug because their section was considered as free from noise even if they were disturbed by noise emitted from fabrication part. This one a dangerous situation which can lead other workers of other section to NIHL through time. No engineering controls like noise absorbent materials or

acquistics materials were not found to reduce excessive noise or administrative controls (work rotation) especially in finishing, fabrication and forging were not applied to minimize the workers exposure to noise.

There was no an ongoing preventive health program to educate employees in safe level of noise and exposure, effect of noise on their health, no training repeated annually for employees exposed to continuous noise level above 85dB A. Noise level make voice communication between employees difficult was not identified and posted. Hearing protective equipment (noise attenuation devices) were available almost to every employee work in areas where continuous level exceeds 85dB A but the main problem was employees didn`t appropriately and always use it properly because they complain, the Ear plug, which mainly provided by the industry was caused discomfort to the worker during job, and also ear inflammation or irritation of the ears.

The industry has safety department but they lack a professional with occupational health and safety or industrial hygienist background. They tried to arrange safety materials, safety rules also posted at each department of the industry with common language (Amharic) to make it clear. They were also tried to enforce the workers as they use hearing protective devices or other safety materials but many of them appropriately and always didn`t use it. Especially for sections like Forging and Fabrication Ear plug is not the appropriate HPD to protect employees from noise. The other thing observed in forging department was that there was image posted (fig.8.3 and 8.4) show that workers in that section as always wear Ear muffs to protect himself/herself from effect of noise but the workers didn`t use ear muffs even some of them didn`t use ear plug in order to protect themselves from noise effect. Even in case of using ear plugs they didn`t properly fitted and always use the ear plugs HPD. But relatively those sections like Forging, Fabrication, Finishing and Pattern used HPD when compared to others.

Fig 6.1 safety rules posted in compound

Fig 6.2 safety rules posted in every section

Fig 6.3 shows as employees in this section always wear ear muffs

Fig. 6 Figures that show the application of safety and safety rules among Akaki basic metal Industry workers, Addis Ababa, June, 2015

No employees exposed to continuous noise above 85dB A given periodic audiometric testing by industry`s clinic or safety department to ensure that weather the industry had an effect hearing protection system or not. Over all this Industry when compared to sister industries like where pretest was done it was better on safety rules but still it is better focus is given on employees' behavioral change towards safety.

6 Discussion

This institutional -based study attempted to assess the prevalence and determinants factors of Noise induced hearing loss among Akaki Basic Metal Industry workers. In addition, the study tried to investigate the level of noise emitted from every sections of the industry.

This study revealed that the prevalence of NIHL among Akaki Basic Metal industry Workers was 22% (95% CI 17 - 27) which can be comparable with other industry set up of other studies. This value was lower than the prevalence done in Dire Dawa Textile Industry, Ethiopia which was revealed 34%, ((15)) and 28.2% in Nigeria which was done on Steel rolling Factory (13), 34.9% India (35) and similar with metal workers in Hong Kong 18.6 % (30). But higher than study carried out in a metal working company providing in Rio de Janeiro, Brazil revealed 15.9% (31). These differences may happened due to the difference level of noise emitted, different hearing conservation program, different exposure levels of the workers and awareness level of the countries on the impact of noise.

In this finding 40% of workers were exposed above 90 dB A for Leq 8-hr daily irrespective of exposure level. But, The Ethiopia occupational safety and health directives regulation shows that for noise, the level of noise and respective time exposure is 90dBA for 8hrs, 92dBA for 6hrs, 95dBA for 4hrs, 97dB A for 3hrs, 100dB A for 2hrs, 102dB A for 1and ½ hrs, 105dBA for 1hr, 110dB A, for ½ hr 115 dB A for ¼ hrs which lines with OSHA standards (29). Similarly in other countries also finding shows as the worker exposed above permissible exposure level of their standard value. In Ethiopia, the study done on assessment of noise level of Metal and Textile industry revealed that as 26.2% of the workers were exposed above Permissible level or above (90 dB A) for 8- hr time weighted average (16). In Hong Kong also 36% of metal Industry workers exposed above 90 dB A (30). Specifically in this finding those sections like forging, fabrication, finishing were above the standard which align with the study done on India Heavy industry (33). The reason behind in this sections is that, there was hammering of metals and grinding which produces high level of noise and also the magnitude or level of noise emitted during hammering and grinding based on the thickness and type of metals being hammered and grinded. In this finding the noise level emitted from Fabrication and Forging even if they were higher than the national standards by their nature they were not continuously exposed to this level and their burden of noise exposure was based on the time of production. That mean when

the industry order those sections for production for different project the noise level become very higher but become lower when there was no order. Especially in forging sections those machines that emit higher noise may stop work even for weeks, at that time exposed to low level of noise for simple works.

6.1 Factors related to the prevalence of NIHL

The predictive factors that were related with NIHL were previously exposure to noise, service year or year of exposures and sex.

This finding showed high service year or long exposure years to noisy work environment significantly associated with NIHL. This finding aligns with many studies conducted in different countries (13, 15, 20, 22, 25, 31, 32, 34). Because chronic exposure to noise by causing damage to the outer hair cells in the cochlea in the inner ear (20).

In this study finding showed that being male was risk factor for the development of NIHL with the significance relation of [AOR = 8 (95% CI; 1.106-67.022)]. This may be due to high exposure of males to noise than females especially in developing countries (17, 30). In this study out of a total of 244 participants 200 males and 44 females only 1 (one) female developed whereas 53 males were developed NIHL, this indicated more males were exposed when compared to females and the case why confidence interval very wide which was epidemiologically difficult to deals about the association with this number of female workers.

The other factor which was significantly related with NIHL in this finding was previously exposure of the workers to noisy work environments after adjusted for other factors. This finding was aligned with the study conducted among mining workers in Tanzania (14). This one is due to the nature of NIHL, because one the hair cells become damaged it becomes permanent. NIHL is sensor neural hearing loss. So one individuals affected with noise it becomes permanent that was the case why those individuals exposed in previous become positive with NIHL(23, 24).

The noise level found in this study was not significantly associated with NIHL when included in the model. But in bivariate analysis the level of noise exposure level for 85 – 90 dBA and > 90 dBA were significantly associated with COR 3 (95% CI 1.353- 7.435) and COR 2.5 (95% CI 1.150 – 5.399) respectively when compared with below 85dB A. In cross tab analysis also noise was significantly associated to NIHL with $X^{2} =$ 8.259, df= 2 and P = 0.016. But in other study it was revealed as the level of noise one of the determinant factor (13, 15, 25, 30). This may was occurred due to the workers found in the sections with high noise level were young age and with low service year in noisy area. In recent time, there was a time the senior worker left the industry and especially from fabrication including other sections and because of this the workers were new generations. Not only this also those workers now work in low level noise areas background were those worked in high level noise areas like fabrication, forging and finishing area that was the case why previous noise exposure significantly associated with NIHL. Other additional factors that contribute for this insignificance might be those workers in high noise level relatively used HPDs always and appropriately than other groups. Additionally exclusion of administrative workers from the study to compare high noise level in production found to low level in administrative staffs also contribute as noise level become insignificant because workers in production department exchange among sections and diffusion of noise among the sections. That was why almost all workers in production department exposed to noise and the finding couldn`t appreciate the effect of noise level. This finding didn`t mean that noise is not a predictive factor for NIHL, but in this population where this study conducted on revealed this truth based on population characteristics.

Regarding to usage of hearing protective devices (HPDs), 148 (60.8%) of the workers were used hearing protective devices. But in other study usage of HPD varies from without protective equipment(15), 10% of the worker (36) and 23.8% of the workers used hearing protective devices in noisy environments(16). The main problem in this finding was that the proportion of users of HPDs those when compared to non-users were almost equally developed NIHL. This indicated that workers were not used properly HPD to protect themselves from the effect of noise. As indicated in the above result when the proportion of users proportionally calculated even the proportion of users were highly affected with NIHL. The other things what was considered in this finding was the type of HPDs used irrespective of the level of noise. Almost all of the workers found in this Industry used Ear plug types of Hearing protective devices but

there were sections need only Ear muffs. For noise level above 98 – 115 dB A the workers must use Ear muffs (38).

So far the observational checklist no material that can reduce noise level emitted each every sections of the Industry was maintained that aligns with Dire Dawa Textile Industry (15). Workers even if they were provided HPD they didn`t used it and complain that as it is not comfortable for them this reason aligns with other findings (33, 34, 36).

7 Strength and Limitation of the study

- ❖ Strength
  - Being a combination of questionnaire, physical examination, Audiometer measurement, environmental noise measurement and environmental observational check list methods.
- ❖ Limitation
  - It can`t be generalized for other metal industries since it was only one industry.
  - Lack of literature that were done on basic metal Industries.
  - Working space –a big hall where workers from various sections operate- noise defuse
  - Majority of factory workers were male- that was why to conclude being male as risk was difficult
  - Majority of the workers were less experienced

8 Conclusion and Recommendation

❖ Conclusion

The magnitude of noise induced hearing loss among the workers shows that as noise is one of the physical problem that is found in Akaki basic metal industry and causes negative health effect on the health of workers.

- The noise level in Akaki basic metal industry is higher in many of sections of the industry especially in fabrication, Forging, Finishing, Pattern and Hand tools but relatively low in sections like Nonferrous and melting.
- The prevalence of NIHL is more related with the level of noise, 4.5% in below 85 dB A, 6.5 % in 85- 90 dB A and 11% in above 90 dB A of total 22% prevalence rate.
- The major factors related with NIHL were the duration of exposure or service year and previous exposure to noisy works.

❖ Recommendation

Based on the study findings, the recommendation for different organ may be as follow

For industry Administration

- Implementation of hearing conservation programme for the industry.
- Should do pre- employment hearing audiometric test as baseline test or especially during new employees join the industry as medical checkup.
- Should give periodic audiometric test to employees exposed to continuous noise above 85 dBA to ensure that the industry have an effective hearing protection system.
- It is better if the industry Identify the Fabrication department from the rest of Machine parts` section and it may reduce the risk of other sections worker found in Machine part and especially personal protective measure is considered for the fabrication sections.
- Engineering modifications of buildings and machinery to reduce noise levels,
- It is better if acoustics materials installed as annexed below, Annex VIII.

- It is better if the area where engineering control is not feasible, apply administrative controls (work rotation) to minimize individual employee exposure to noise especially in Fabrication, Forging, Finishing and pattern.
- It is better if the industry has occupational health and safety personal to monitor and evaluate the occupational hazards emitted from different part of machines and industry.

For Safety department

- Should form hearing conservation program team which comprise of occupational hygiene officer, safety officers, nurse, employees representative, and from administrative part that should accomplish the following activities:-

- Conduct ongoing preventive health program to educate employees in safe level of noise and exposure effects of noise on their health and use of personal protection.
- Identify the noise hazard and evaluate the risk involved
- Provide suitable hearing protectors or according to noise level of respective sections and ensuring the proper use of the hearing protectors by the workers.
- Measure sound level of industry using sound level meter and kept the records.

For workers

- It is better if worker used HPD frequently during their work and also check properly fit to their ear always while they used.
- It is better if they made using HPD as their culture rather than using it as in fear of safety workers or administrators.
- Workers should form safety teams and discuss about their safety at work places.

For Ministry of labor and social affairs

- Develop rules and regulations that enforce hearing conservation programs at industries level
- Should develop noise prevention strategy.
- Should clear compensation mechanisms for workers victimed by the impact of noise, such as NIHL.
- Should equipped with materials and competent professionals like doctor of occupational medicines, occupational therapists, occupational nurses, industrial hygienists and others to monitor; measure, record, report the impact of noise and also enforce rules and regulations designed by the ministry appropriately.
- It is better also if intersect orally collaborate with respective ministries to prevent noise induced hearing loss at work places and additionally share experience of developed countries to prevent and control noise induced hearing loss.

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10 Annexes

Annex I

Participant information sheet in English

Addis Ababa University

Faculty of Medicine

School of Public Health

You have been chosen the participant in this study which is, Assessment of Noise induced hearing loss among Akaki Basic Metal Industry workers, in Addis Ababa. Please read the following statements and ask any unclear questions before you agree to participate.

1. **Topic:** Noise Induced Hearing Loss among Akaki Basic Metal Industry workers, Akaki town, Addis Ababa
2. **Objective of the study**: The objective of this study is to assess the prevalence of Noise induced hearing loss and to measure level of exposure of Akaki Basic metal industry workers. And this information collected from you serve as a base line information for the country to take a corrective action and to identify the magnitude of the problem in the country as well as to Proper implementation of occupational health law and standards in countries has also shown to bring about a significant reduction of occupational noise hazards.
3. **Participation procedure and Guidelines:**
   The information you provide will be kept completely anonymous. Your name will not written on the questionnaire. You answers are completely confidential/. The questions are prepared in Amharic. It will take only about 20 minute to complete the interview.
4. **Participant Benefit and risk:**
   Your participation in the study does not involve risks. You also may experience some benefits from participating in this study. You will be advised how u protect yourself from the effect of noise and use hearing protective devices properly. If you are one of

participant affected with NIHL, Necessary arrangements will be made with the factory management to provide counseling and referral for further diagnosis and treatment.

5. **Study design:**

   Institutional based cross sectional study will be conducted from February – March, 2015

6. **Rights to refuse or withdraw**:

   a. You don't have to answer any questions that you don't want to answer.

   b. You have a full right to withdraw from the study at any time.

7. **Right as a participant**

   You have a right to ask any question(s). If you need clarification on the study please contact:

Ashenafi Hailu

Addis Ababa University, Medical Faculty, School of Public Health

Cell Phone: 0922602296

E-mail ashenafihl@gmail.com

Thank you

Annex II

የሰራተኞች የተሳታፊነት መረጃ ፎርም

በአዲስ አበባ ዩቨርሰቲ ሜዲካል ፋኩልቲ ሄልዝ ት/ቤ የሚጠና ጥናት

እርሶ በአቃቂ በዝክ ሜታል ኢንዱስትሪ ውስጥ በሚትገኝ ሰራተኛ በድምጽ ብክለት እና ጆሮ ላይ ለሚያስከትሎ ችግሮች ላይ በሚደረገው ጥናት ውስጥ እንድትሳተፉ ተመርጠዉል፡፡ ከታች የተዘረዘሩትን ሀሳቦች ካነበቡት በኋላ ያልገባዎት ነገር ካለ ከመስማማቶ በፊት እንድትጠይቁ በትህትና እጠይቃለሁ፡፡

1. የጥናቱ አላማ፡ በአቃቂ በዝክ ሜታል ኢንዱስትሪ ዉስጥ የሚገኘዉን የዲመምጽ መጠን ለመለካት እና ሰረተኛዉም ላይ ያደረሰ ችግር ካለ የችግሩን መጠን ለመለካት ያለመ ነዉ ፡፡ ይህ ደግሞ በሀገረተቷ ዉስጥ ያለዉን የስራ ቦታ ደህነት ህጉን ትኩረት እንዲሰጠው ይረዳል፡፡
2. ለተሳታፊዎች መመሪያ፡ እርሶ የምትሰጡት መህረጃ ለማንም ሳይነገር ሚስጥራዊነቱ የተጠበቀ ይሆናል ስም በዚህ መጠየቅ ላይ አይፃፍም ወይም አይሞላም ፡፡ ቃለ መጠየቁን ለመሙላት 20 ደቂቃ ይወስዳል፡፡
3. የተሳታፊዎቹ ጉዳትና ጥቅም፡ በዚህ ጥናት ላይ በመሳተፎ የሚያመጣውን ጉዳት የለም ፡፡ ጥቅሞች ግን ስለ ድምጽ ብክለት ለሚያስከትሉት ችግሮች እና መፍተኃኞ እንድሁም መከለኪያ ዘደዎቻቸዉን ግንዛቤ ያገኛሉ፡፡ አጋጣሚ ሆኖ እርሶ የችግሩ ተጠቅ ብሆኑ ከማነጅመንቱ ጋር በመተባበረ የምክር እና የህክምና አገልግሎት እንዲያገኙ ዘንድ ጥረት ይደረጋል፡፡
4. በጥናት ላይ ለመሳተፍ ያለመፈለግ፡ መመለስ የማትፈልጉ ከሆነ የግድ መመለስ የለቦትም በማንኛውም ጊዜ ቃለ መጥያቁን ማቆም ሙብቶ የተጠበቀ ነዉ፡፡
5. የተሳታፊዎች መብት፤ ጥናቱን በተመለከተ ተጨማሪ ማብራሪያ ወይም ጥያቄ ካሎት በሚከተለው አድራሻ መጠየቅ ይችላሉ፡፡

አሸናፊ ኃይሉ

ስልክ ቁጥር 0922602296

ኢሜል ashenafihl@gmail.com ማድረግ ይችላል

Annex III: Consent form before conducting interview

Name of industry_____ Name of the department _____

Name of the working section_____

Greeting

Hello, I am_____. I am working in the research team of Addis Ababa University, school of public health, Department of preventive medicine. I would like to ask you a few questions about noise related to your occupation. This will help us to improve occupational safety, health and working environment services provided to you based on your answer to our questions. Your name will not be written in this form and will never be used in connection with any information you tell us. All information given by you will be kept strictly confidential. Your participation is voluntary and you are not obliged to answer any question you do not wish to answer. If you fill discomfort with the interview please fill free to drop it any time you want. This interview will take about 20 minutes. Do I have your permission to continue?

1. I f yes, continue to the next page
2. If no, skip to the next participant by writing reasons for his/ her refusal

Informed consent Certified by

Interviewer: Code_____ Name_____ signature_____

Date of interview_____ Time started_____ Time completed_____

Result of interview: 1.Completed 2.Respondent not available 3.Refused 4. Partially completed

Checked by Supervisor: Name_____ signature_____ Date_____

For any inconvenience and problem you can contact the principal investigator.

Ashenafi Hailu,

Phone -0922602296 E-mails- ashenafihl@gmail.com

Annex IV: Amharic version consent form

መለያ

የኢንዱስትሪ ስም ---------- የዲፓርትመንቱ ስም ---------- ክፍል ----------

ቃለ መጠይቁን በማድረግ በፍት የተሳታፍዎች ፍቃድኝነት መጠየቅያ ቅጽ

ሰላምታ ፡ እንደምን አሉ? እኔ አቶ/ወ/ሮ/ ወ/ት ---------- እዝህ የመጣሁት ይህንን ጥናት የሚያከህድ የአዲስ አበባ ዩኒቬርሲቲ ጤና ሳይንስ ኮሌጂ የህብረትሰብ ጤና ት/ ቤት የፐሪቬንቲቭ ሜዲሲን ት/ክፍል ቡድን አባል ሁኜ ነዉ።።

ከዝህ በመቀጠልም ከስራዎ ጋር በተየያዘ ስለ ድምጽ ብክለት ኢጥይቆታለሁኝ።። ከእርሶ የሚገኘዉ መልስ በሀገራችን ለሚከናወነዉ የሙያ ደህነት የስራ አከባቢ አገልግሎትን ለማሻሻል ከፍተኛ እገዛ ይኖረዋል።።

ከእርሶ የሚናገኛቸዉን ማንኛዉንም መልስ በምስጥር እንጠብቃለን።። ከዝህ ጥናት ጋር በተየያዘ በማንኛዉም ቦታ እና ጊዜ ስምዎ እነዳይጻፍና እነደማይጠቀስ ልንገልጽለዎ እንወዳለን።። በአጠቃላይ መጠይቁ ወደ 20 ደቂቃ ገዳማ የሚወስድ ስሆን በጥናቱ የሚሳተፉት የእርሶን ሙሉ ፍቃድኝነት ስናገኝ ብቻ ነዉ።። በመጠይቁ ሂደት ለመመለስ የማይፈልጉትን ጥያቄዎችን ያለመመለስ መብተዎ የተጠበቀ ነዉ።።

በጥናቱ ለመሳተፍ ፍቃደኛ ነዎት

ነ አዎ ---------- ወደሚቀጥሎ ይሻገሩ

2 የለም ---------- ፍቃደኛ ያልሆኑበትን መክንያት በመጻፍ ወደ ሌላ ተጠያቂ ይሸጋገሩ።።

ፍቃደኝነትን ያረጋገጠዉ የጠያቂ መለያ ቁጥር ---------- ስም---------- ፍርማ---------- ቀን---------- መጠይቁ የተሞላበት ቀን---------- የተጀመረበት ሰኣት ---------- የተጠናቀቀበት ሰኣት ----------

ስለረጋገጠዉ የተቆጣጣር ስም ---------- ፍርማ ---------- ቀን ----------

ዉጤት

1. ተጠቃሏል
2. ተጠያቂዉ አልተገኙም
3. ተጠያቂዉ ተቃዉመዋል
4. በከፍል ተጠናቋል

ማንኛዉም ማህረጃ ለማግኘት አጥኝዉን በምቀጥሎ አድራሻ ማግኘት ይቻላል።።

አሸናፊ ኃይሉ

ስልክ 0922602296፣ E-mails- ashenafihl@gmail.com

Annex V: Questionnaire by English Version

Questionnaire to assess Noise induced hearing loss among Akaki basic metal industry workers

Questionnaire ID_____ Filled by _____

No	Question	Possible answers	skipping	Response code
Part I: socio – demographic characteristics				
101	sex	1. Male 2. Female		
102	Age	_____ years		
103	Religion	1. Orthodox 2. Muslims 3. Protestant 4. Catholic 5. Other specify _____		
104	Marital status	1. Single 2. Married 3. Divorced 4. Widowed		
104	Educational status	1. Illiterate 2. Read and write 3. Primary (1-8 grades) 4. Secondary (9-12 grades) 5. Technical/College diploma 6. Degree /above		
106	Total service year in this industry	_____ months _____ years		
Part II : personal and work related information				
107	Do you have a second job?	1. Yes 2. No	*	
108	If yes what? Please specify	_____		
109	Have you ever worked in noisy area prior to this job?	1. Yes 2. No	*	

110	If your answer is yes what type? Please Specify it			
111	Have you ever been in military services?	1. Yes 2. No	*	
112	If your answer is yes have you ever had participate in battle war or exposed to high explosive sound or gunshot?	1. Yes 2. No		
113	Have you had previous hearing test?	1. Yes 2. No		
114	Have you had a cold in the last fortnight (last two weeks)?	1. Yes 2. No		
115	Did you have any history of hearing loss factor to this job?	1. Yes 2. No		
116	Have you ever had ear discharge or trauma or infection?	1. Yes 2. No		
117	Have you ever had head injury?	1. Yes 2. No		
118	Which of any of these illnesses etc. that you have had?	1. Bacterial meningitis 2. Mumps / Measles 3. Scarlet/ rheumatic fever 4. Epilepsy 5. TB treated 6. ENT treatment		
119	Have you ever had a broken ear drum?	1. Yes 2. No		
120	Do you have ear problem now?	1. Yes 2. No		
121	Do you fill you have hearing problem?	1. Yes 2. No		

122	Do you fill that there is difference between two ears?	1. Yes 2. No		
123	Do you have any ringing/ trouble noise in your ear or head?	1. Yes 2. No		
124	If Yes for how long period of time?	_____	*	
125	Has anyone in your family lost hearing before age 50 years?	1. Yes 2. No		
126	Are you taking now or regularly medications?	1. Yes 2. No		
127	If yes what?	_____	*	
128	Do you have hypertension?	1. Yes 2. No		
Part III Behavioral characteristics				
129	Do you drink alcohol?	1. Yes 2. No		
130	If yes how often?	1. Rarely (monthly) 2. Occasionally (monthly or weekly) 3. Frequently (weekly or daily) 4. Daily	*	
131	Do you smoke cigarettes?	1. Yes 2. No		
132	If yes, how many per day?	_____(packet)	*	
135	Do you use any Hearing Protection Devices to protect your ear while at work?	1. Yes 2. No		
136	If yes what type ear protection you use?	1. Ear muffs/head phones 2. Ear plugs 3. Ear caps 4. Others	*	
137	If yes for how frequency you use?	1. Always 2. Sometimes 3. Rarely		

138	If No, why?	1. Not available 2. I know nothing about it 3. I don`t believe on its use 4. Is not comfortable for use 5. Other reason		
139	Have you had any occupational safety training / education?	1. Yes 2. No		
140	1. How long since your last training/education?	------ days/months/years		

* skipping

Results for Measurements

141. Blood Pressure _____

142 Average noise level in work department dBA _____

143. Otologic Examination is normal? 1. Yes 2. No

144. Audiometric Examination

Frequency in Hz	250	500	1000	2000	4000	6000	8000	Pure tone average
Hearing level in dBA								
Right ear								
Left ear								

Annex - VI Amharic Version of Questionnaire

ይህ መጠይቅ በአቃቂ ቤዝክ ሜታል ኢንዱስትሪ ሰራተኞች መካከል ከዲምጽ ጋር የተየያዙ ጀሮ ላይ ለሚያደርሱ ችግሮችን ለማጥናት የተዘጋጀ ነዉ::

የመጠየቂያ ቅጽ መለያ ቁጥር ----------

መጠይቁን የሞላ ስም ----------

ክፍልን አንድ ፤ ማህበራዊ ስነ ህዝብ በተመለከተ				
ተ/ቁ	ጥያቀ	አማራጭ መልሶች	መሸጋገር	ኮድ
101.	ጸታ	1. ወንድ 2. ሴት		
102	እድሜ በአመት	----------		
103	ሀይማኖት	1. ኦርቶዶክስ 2. ሙስልም 3. ፕሮተስታንት 4. ካቶሊክ 5. ሌላ		
104	የት/ት ደረጃ	1. መጻፍና ማንበብ የማይችል/የማትችል 2. መጻፈ እና ማንበብ የሚችል/የሚትችል 3. የመጀመርያ ደረጃ ት/ት (1-8) ያጠናቀቀ/ች 4. ሁለተኛ ደረጃ ት/ት(9-12) ያጠናቀቀ/ች 5. ከተክኒክና ሙያ ት/ት ቤት የተመረቀ/ች 6. ዲግሪ እና ከዛ በላይ		
105	የጋብቻ ሁኔታ	1. ያላገባ/ች 2. ያገባ/ች 3. የፈታ/ች		

		4. የሞተችበት/ ባት 5. አግብቶ/ ተለያይቶ የሚኖሩ		
106	የአገልግሎት ዘመን በአመት	----------		
ክፍል ሁለት ፤ ከስራ ጋር በተየያዘ				
107	ሌላ ተጨማሪ ስራ አለዎት ?	1. አዎ 2. የለም		
108	ካለዎት ምን ?	----------		
109	ከዝህ በፍት ተመሳሳይ ወይም ከፍተኛ ድምጽ ያለዉ ስራ ሰርቷል ?	1. አዎ 2. የለም		
110	ከዝህ በፍት ያለመስማት ችግር አጋጥሞት ያቃል ?	1. አዎ 2. የለም		
111	ከዝህ በፍት የጆሮ እንፈክሽን ወይም መግል ወይም አደጋ አጋጥሞት ያቃል ?	1. አዎ 2. የለም		
112	ከዝህ በፍት ጭነቅላቶ ለይ አደጋ ደርሶ ያቃል ?	1. አዎ 2. የለም		
113	ከዝህ በፍት የጆሮዎት ታመቡር ተበጥሶ ያቃል ?	1. አዎ 2. የለም		
114	አሁን የጆሮ ችግር አለቦት?	1. አዎ 2. የለም		
115	አሁን የመስማት ችግር አለቦት?	1. አዎ 2. የለም		
116	በሁለቱ ጆሮዎት መህከል የመስማት ልዩነት አለ ብሎ ያስባሉ?	1. አዎ 2. የለም		
117	ጆሮዎት ዉስጥ የደዉል ድምጽ ይሰሞታል?	1. አዎ 2. የለም		
118	በቤተሰቦ ዉስጥ ከ50 ዓመት ዕድሜ በፍት መስማት የተሳነዉ ሰዉ አለ?	1. አዎ 2. የለም		
119	አሁን ወይም ሁሌ የምወስዱት መድሃንት አለ?	1. አዎ 2. የለም		
120	አዎ ከሆነ ምን	----------		

ክፈል ሦስት ፤ ከሰራተኛዉ ባህሪ ጋር በተየያዘ				
121	አልኮሆል ይጠጣሉ?	1. አዎ 2. የለም		
122	አዎ ከሆነ ስንት ጊዜ?	1. በወር አንደ 2. በወር ወይም በሳምንት አነደ 3. በየሳምንቱ 4. በየቀኑ		
123	ስጋራ ያጨሳሉ?	1. አዎ 2. የለም		
124	መልሶ አዎ ከሆነ በቀን ምን ያህል ያጨሳሉ?	--------- (በፍሬ) --------- (በፓኮት)		
125	ጫት ይቅማሉ?	1. አዎ 2. የለም		
126	መልሶ አዎ ከሆነ ስነት ጊዜ?	1. በወር አንደ 2. በወር ወይም በሳምንት አነደ 3. በየሳምንቱ 4. በየቀኑ		
127	የጆሮ መከላኪያ መሳርያ ይጠቀማሉ?	1. አዎ 2. የለም		
128	መልሶ አዎ ከሆነ ምን አይነት መሳርያ ይጠቀማሉ?	1. ኢር ማፍስ 2. ኢር ፕላግስ 3. ሌላ ካለ ይጥቀሱ ---- ----------		
129	መልሶ የለም ሀሆነ ለምን?	1. መሳርያዉ ሲለሌለ 2. ሰለ መሳርያዉ ብዙም ዕዉቀት ሰለለኝ 3. ለመጠቀም ሰለማላምንበት 4. ምቾት ሰለመይሰጠኝ 5. ሌላ ካለ ይጥቀሱ ----		

139	ከዝህ በፍት ስለ ስራ ቦታ ደህነት ስልጠና ወስዶ ያዉቃሉ?	1. አዎ 2. የለም		
140	ስልጠናዉን ከወሰዱ ምን ያህል ጊዜ ሆኖታል ?	---------- (ቀናት/ ወራት/ ዓመት)		

Annex VII. Environmental noise observational checklists adapted from Hazard analysis checklists.

1. Are there areas in the workplace where continuous noise levels exceed 85 dBA?

1. Yes 2. No

2. Is there excessive noise in the workplace difficult to communicate nearby workers?

1. Yes 2. No

3. Have work areas where noise levels make voice communication between employees difficult been identified and posted?

1. Yes 2. No

4. Are noise levels being measured using a sound level meter or an octave band analyzer and records being kept?

1. Yes 2. No

5. Have tried isolating noisy machinery from the rest of operation?

1. Yes 2. No

6. Have engineering controls been used to reduce excessive noise levels?

1. Yes 2. No

7. Where engineering controls are determined not feasible, are administrative controls (i.e. worker rotation) being used to minimize individual employee exposure to noise?

1. Yes 2. No

8. Is there an ongoing preventive health program to educate employees in safe levels of noise and exposure effects of noise on their health, and use of personal protection?

1. Yes 2. No

9. Is approved hearing protective equipment (noise attenuating devices) available to every employee working in areas where continuous noise levels exceed 85 dBA?

1. Yes 2. No

10. If they use ear protectors, are employees properly fitted and instructed in their use and care?

1. Yes 2. No

11. Are employees exposed to continuous noise above 85 dBA given periodic audiometric testing to ensure that you have an effective hearing protection system?

1. Yes 2. No

12. Does the industry have health and safety personnel that develops written health and safety programs to educate and prevent them from noise hazards?

1. Yes 2. No

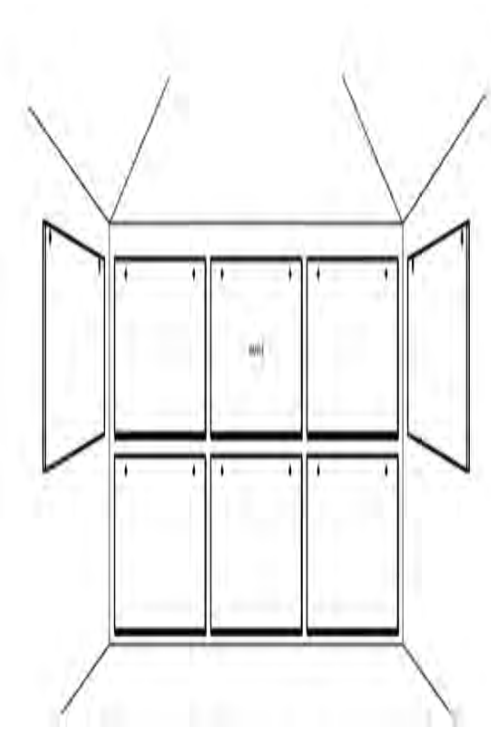
13. Do workers exposed to low to moderate levels of chemicals like carbon monoxide, hydrogen cyanide, toxic chemicals, and industrial metals such as mercury?

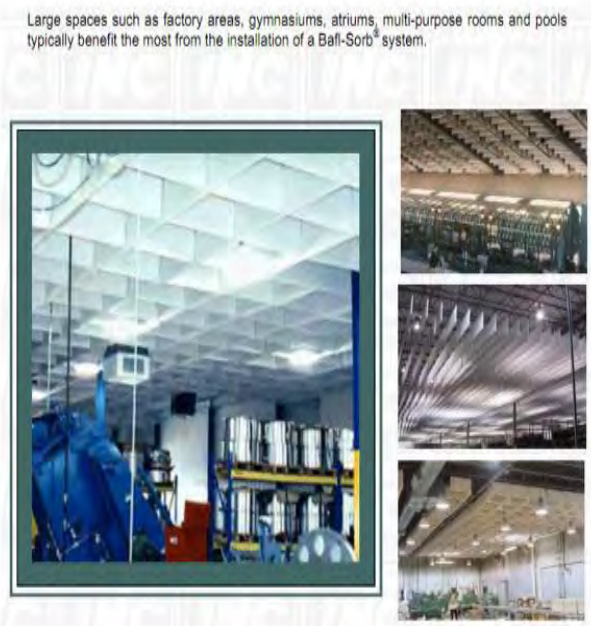
1. Yes 2. No

14. Is there excessive heat in the workplace which cause that a worker is found sweating when naked or with light clothing and investigator feels as sudden heat wave when entering in to the industry?

1. Yes 2. No

Annex VIII Acoustic materials that can be installed at different positions with in industry





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