International Research Journal of Applied and Basic Sciences
© 2014 Available online at www.irjabs.com
ISSN 2251-838X / Vol, 8 (10): 1685-1690
Science Explorer Publications

Assessing the Occupational Noise in Workplaces at Local Levels

***Vahid Novin[1], Saeed Givehchi[2], Hassan Hoveidi[2]**

1. Graduate student of health and safety, Graduate Faculty of Environment, University of Tehran
2. Assistant Professor, Graduate Faculty of Environment, University of Tehran

***Corresponding Author email:** vanovin83@gmail.com

ABSTRACT: Noise-induced hearing loss (NIHL) is a major occupational health problem that can be prevented through the use of hearing protection devices (HPDs). The objective of the paper was the accomplishment of a survey ofNoise-induced hearing loss in a small city. A case study design was utilized to identify, describe and evaluate noise sources, exposures and control strategies used by those "high", "moderate" and "low" risk industry sectors in relation to exposure to noise. The present study involved the pretest data collected as a part of an ongoing hearing protection and cardiovascular disease prevention intervention study.It was found that of the "high risk" industry sectors surveyed, most had mean and median sound levels that were at or above $L_{Aeq.8hr}$85dB.Engineering and construction businesses had the greatest percentage of employees exposed to noise levels above 85dB $L_{Aeq.8hr}$ (85%, 83%). Noise exposure in these industries were some of highest recorded in this study. (Median $L_{Aeq.8hr}$ range 83.5 – 95dB).From the findings of the present study, it would appear that lack of prioritization of noise exposure and perceptions of the seriousness of NIHL over other things affecting the business are key cultural barriers facing effective noise management at workplaces in developing regions.
Key words: Occupational noise, job safety, evaluation of exposure, sound levels, sources and paths

INTRODUCTION

The ability to hear well is important to our quality of life, including learning, communication, safety, and job performance. However, repeated exposure to loud noise gradually damages sensory cells in the inner ear and causes hearing loss(Cheesman & Steinberg, 2010). Noise-induced hearing loss (NIHL) is an irreversible condition for which there is currently no effective medical treatment but it is almost always preventable. Occupational noise exposure is the most common cause of NIHL and is one of the most significant occupational health problems in work places(Barrenäs & Holgers, 2000). Certain groups of workers, such as factory workers, construction workers, and farmers, are often in contact with equipment that generates unsafe noise levels. The Occupational Safety and Health Administration (OSHA) provides for standards to protect the hearing health of workers exposed to noise on the job. These standards require that workers be included in a hearing conservation program when exposed to 85 dBA and greater time-weighted average (TWA) noise exposure; and that at 90 dBA TWA the use of hearing protection becomes mandatory, as is the investigation of feasible engineering or administrative controls(Bilbao, 2007).The predominant noise control strategy used by the businesses was the use of personal hearing protection. Although many operations were complex, noise management strategies aimed at the noise source and noise paths could have been investigated further(Canetto, 2007).

Noise sources in the manufacturing sector are extremely varied and very much dependent on the manufacturing process and equipment and machinery used in the process. Kock et al (2004) surveyed in excess of 800 companies in high risk (predominantly manufacturing) industries in Denmark and identified noise exposures related to the activities within the industry sector rather than specific noise sources (Ide, 2007). Occupational exposure to elevated sound levels is dependent on a variety of factors, including: (a) occupation and industry, and (b) workplace-specific factors, such as type of facility and process, raw materials, machinery, and use of personal protective devices. Tak et al (2009) estimated that one in six US workers (17%) is exposed to workplace noise that is loud enough that they had to raise their voice to be heard (Girard & Picard, 2004). Williams et al (2008) found that noise in excess of 85dB(A) was observed in 73% workplaces; exposures exceeding national standards were in 45% sites; around 50% workplaces were aware of new noise regulations (Adera & Anderson, 2000).

Noise sources in the manufacturing sector are extremely varied and very much dependent on the manufacturing process and equipment and machinery used in the process. Occupational exposure to elevated sound levels is dependent on a variety of factors, including: (a) occupation and industry, and (b) workplace-specific factors, such as type of facility and process, raw materials, machinery, tools, the existence of engineering and work practice controls, and the existence, condition, and use of personal protective devices (Nelson et al, 2005). Williams et al (2008) found that noise in excess of85dB(A) was observed in 73% workplaces; exposures exceeding national standards were in 45% sites; around 50% workplaces were aware of new noise regulations.

MATERIALS AND METHODS

Evaluation of existing noise source, exposures and controls

This section of the survey provided demographic details of the selected organizations, including(Reinhold, 2009):

The physical characteristics and details of work areas assessed

Identification of existing noise sources

Identification of existing noise control strategies

Assessment of the options/ strategies for reducing noise exposure further

Noise exposure data including area noise levels and personal noise dosimeters. Data on exposure to noise were collected including area sound levels and personal sound exposures (noise dosimeters)(Toppila & Pyykkö, 2009). Data were collected by observation and semi-structured interviews with management and, where applicable, safety representatives during site visits. Noise sources and controls were identified in terms of the sources of noise (mechanical, aerodynamic, turbulent flow, other); noise paths (airborne, structure-borne, duct-borne, other) and noise receivers (number affected, location, HPD worn, other comments)(Aybek & Kamer, 2010).

Exposure to noise

The noise surveys used Rion type NA14 precision sound level meters and Cirrus Research dose Badges(Hahn, 2008). A “walk through” survey identified the most noisy areas and activities and these areas were sampled to reflect a “worse case” scenario. Sound levels were measured in accordance with standard methods detailed in the Approved Code of Practice for the Management of Noise (Directive, 2003)and AS/NZS 1269, 1998: *Part 1 Measurement and assessment of noise emission and exposure*. All sound level meters complied with the requirements of AS 1259.1 (IEC 60651) and/or AS 1259.2 (IEC 60804). Sound exposure meters complied with the requirements of IEC 601252. Reference sound sources (calibrators) complied with Class 2 specifications of IEC 60942. Where each workplace provided a range of sound values, the median values for A-frequency weighted time-average level (L_{Aeq}), peak level (L_{Cpeak}) were included for analysis to account for outliers(Reinhold, 2009).

Personal noise dosimeter devices (Cirrus CR: 100B Noise Badge) wereused to ascertain noise levels within the work place(AS/NZS, 2005). The intention was to obtain these measurements for each task carried out by each participant. In cases where it was not possible for the noise dosimeter to beworn by the participant, the noise dosimeter was worn by a substitute employee who worked on the same task in the same work area(Canetto, 2007). It was not possible to observe and supervise the employees wearing the noise dosimeters as there were often up to eight such employees at any one time. Noise versus time output plots were obtained from each episode of measurement, so it was possible to see if a dosimeter was tampered with, such as being left in a quiet room, or showed evidence of noise levels not consistent with the noise environment(Mohammadi, 2008). It was not always possible to obtain noise measurements for every reported task because of limitations, primarily inability to access to work areas (e.g. in petrochemical plant where instrumentation must be intrinsically safe). The dosimeter was attached to the participant‘s shoulder by the researcher, and participants were instructed to carry out their usual tasks(Aybek & Kamer, 2010). Dosimeters were worn for at least 2 hours for each task. Times ranged from 2 hours 38 minutes to 4 hours and 27 minutes; the average time was 3 hours and 38 minutes(AS/NZS, 2005).

Noise control conformance assessment

This section of the survey essentially audited the employers and employees responsibilities under the Health and Safety regulations with respect to noise, utilizing the Approved Instructions of Practice for the Management of Noise in the Workplace. A 20-point checklist was developed for this study; Data was collected through semi structured interviews, observational data and investigation of archival data and information.

RESULTSAND DISCUSSION

Thirty three (33) workplaces and 71 work areas were surveyed in this study. The survey confirmed that the selected organizations within the industry sector were appropriately identified as“high”, “medium” and “low risk” of exposure to noise and NIHL (“high risk” industry sectors had sound levels ≥ $L_{Aeq.8hr}$85dB; “medium risk”, ≥ $L_{Aeq.8hr}$75-85dB; “low risk” ≥ $L_{Aeq.8hr}$ 75-70dB)(Barbeau & Roelofs, 2004). Three organizations had employee counts of over 20 employees and were regarded as medium sized enterprises. The remainder (n=30) had employee counts of less than 20 employees and were regarded as small businesses(Hahn, 2008).

Noise sources and paths

For the high risk industry sectors, the sources were primarily due to impact noise; rotational noise due to machinery, gears, conveyers and electric motors; engine noise; high frequency pneumatic noise due to hydraulic equipmentand operations; pipe noise due to turbulent flow within pressurized steam lines; compressor noise and alarm noise due to operational alarm activation. For the medium and low risk sectors, noise sources tendedto be related to the task,activity and equipment being used and the interaction of other, usually external sources of noise not directly related to the workplace such as traffic noise.Identification of noise paths in relation to the noise sources was complex as it included indoor and outdoor environments. However, airborne paths were the primary route for noise, with some cases of structure-borne and duct-borne noise/vibration transmission.*Table 1 summarizes the noise sources* and paths.

Exposure to noise and Personal sound exposure measurements

A total of 33 workplaces and 71 work areas were surveyed. L_{Aeq8hr} values ranged from below 60dB to 95dB for all employees across all sectors. Mean and (median) L_{Aeq8hr} levels ranged from 69dB (70dB) to 91.8dB (94dB). L_{Cpeak} ranged from 100dB to 138dB. Mean and (median) L_{Cpeak} levels ranged from 116dB (70dB) to 125dB (130dB).

Table 1.Summary of noise sources and paths in industry sector case studies

Industry sectors	Noise sources	Noise paths
Manufacturing	The noise sources consisted of primarily impact noise due to bottle and can contact; rotational noise due to machinery, gears, , vibration noise from the operation of the straight knife and rotary	Open air paths with a large reverberant space in the workshop.No paneling of any type on the walls or ceiling. The noise
Construction	Rotational and impact noise from hand held equipment; saws and drills; pneumatic guns and hammering. The road construction site had noise sources generated by the engine, transmission, and pneumatic operations involved with earthmoving	The noise paths were a combination of structural, reflective and airborne paths
Agriculture (Dairy)	Noise exposures identified on farms included tractors, motorbikes, air compressors, chainsaws, radios and other farm machinery. Sources included engines and gears, pneumatic and hydraulic noise, compressor noise and radio noise	The noise paths were a combination of structural, reflective and airborne paths
Public places	Mechanical/equipment noise from the operation of appliances such as food processors and the coffee machine and the till. Other important sources of noise included traffic, especially from buses stopping and taking off outside the café and noise from patrons. There was also radio noise	The noise paths were primarily a airborne paths, with a minor combination of structural, and reflective paths

Table 2Summarizes details of the workplaces ‘median$L_{Aeq.8hr}$ and L_{Cpeak} levels, and percentage of work areas equal to (=) or greater (>) than 85 dB.Due to the variety of industry sectors and job functions of personnel participating in the survey, noise levels were determined for those productions, operations or other employees who were exposed to noise generated by the business or process during their normal work shift. Most (61%) recording times were in excess of 6 hrs or longer and the $L_{Aeq.8hr}$ was calculated from these data. Shorter recording times were often used as it was impractical to access all employees at the start of their shift.

Table 2. Summary of sound levels of workplace surveys by industry sector

	Manufacturing	Construction	Agriculture (diary)	Public places
No.workplaces	17	3	4	9
No.workareas	36	6	9	20
Median$L_{Aeq.8hr}$	94 dB	90dB	85dB	74 dB
Median$L_{C,peak}$	130 dB	120dB	115dB	110 dB
%workareas> 85dB$L_{Aeq.8hr}$	69	66	55	0

The distribution of $L_{Aeq.8hr}$ and L_{Cpeak} levels for employees across allsectors are shown in Figures 1 and2.A large proportion (>48%) of L_{Aeq} levels recorded were in excess of 85dB.

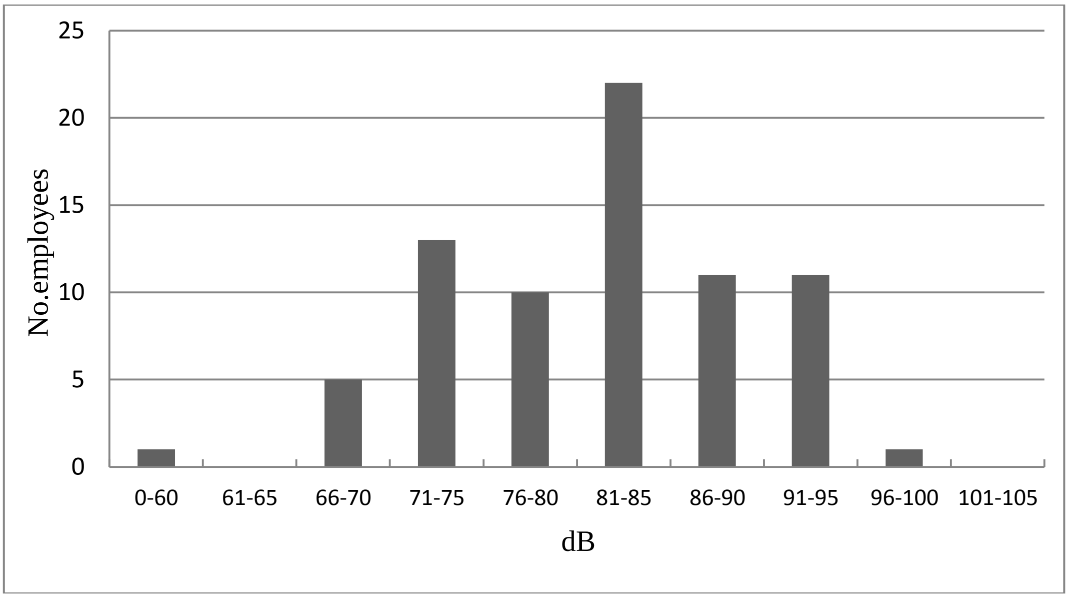

Figure1. Distribution of L_{Aeq8hr} for employees across all sectors

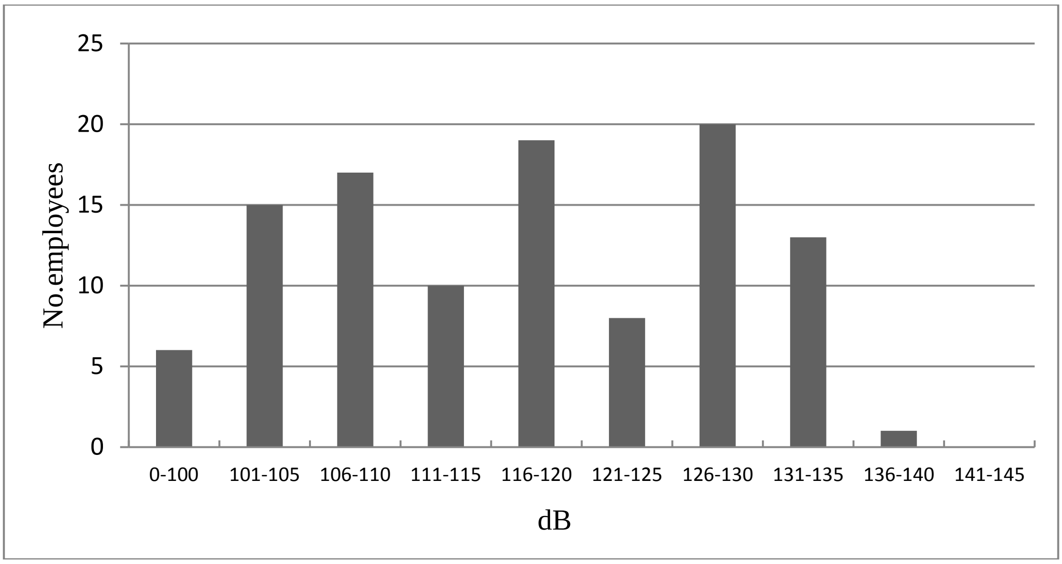

Figure2. Distribution of L_{Cpeak} for employees across all sectors

Noise exposure by sector

Overall, 122 employees in all sectors were monitored by dosimeter and the mean and median noise levels (L_{Aeq}) are shown in Figures 3 Of the “high” risk industry sectors; engineering manufacturing sites and construction operations experienced the highest time average levels with median $L_{Aeq.8hr}$ values of 94 dB and

90 dB respectively. Median L_{Cpeak} levels were also high at 130 dB and 120 dB. Farms included in the agricultural sector surveys had median $L_{Aeq.8hr}$ values of 85 dB, and median L_{Cpeak} level of 115 dB.The low risk industry sectors (public places) had median $L_{Aeq.8hr}$ values of74dB, and median L_{Cpeak}levels of 110 dB respectively.

Noise controls and conformance assessment

The predominant noise control strategy in the majority of organizations surveyed was that of minimization, specifically the use of personal hearing protection. Of the 33 organizations assessed, 20had explored options for elimination and isolation of noise sources. Of those, only 4 businesses had undertaken modifications or replacement of equipment, which resulted in a self-reported reduction of noise exposure in the workplace. The remaining businesses (16) had not pursued these control options. Administrative controls were not used in any of the organizations surveyed.

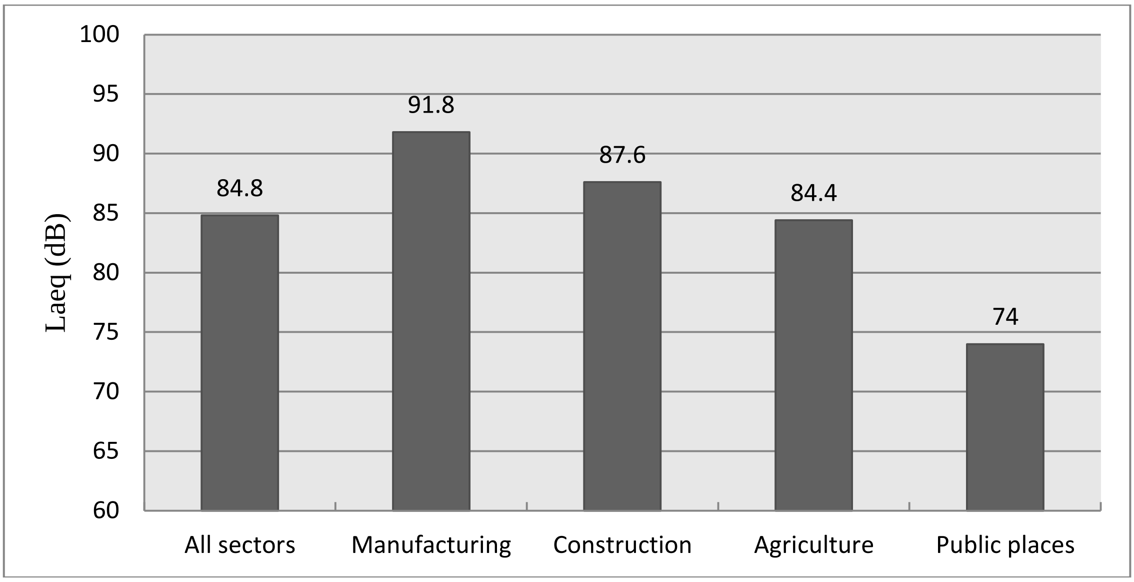

Figure 3. Mean employee L_{Aeq8hr} levels by sector

CONCLUSION

Manufacturing and construction industries in particular demonstrated high potential for noise-induced hearing loss in employees. There appears to be a lack of prioritization of noise exposure as an issue in the workplaces surveyed, and although noise control options at source were considered by most managers/ business owners, these options were not pursued. Even though it is difficult to generalize and promote noise control strategies across all the industry sectors surveyed as these are site, situation and equipment/ machinery/ task specific, a basic understanding of noise enclosure, isolation, barriers and damping was not evident in these businesses. The potential for administrative solutions should be actively pursued by all industry sectors.There is still a need to build a positive focus on safety In order to improve behavior that protects hearing, it may be valuable to increase perceptions of personal susceptibility to NIHL e.g. through audiometric test programs.

REFERENCES

Adera T, Anderson L. 2000. Time trends analysis of hearing loss an alternative approach to evaluating hearing loss prevention programs. American Industrial Hygiene Association Journal , 161-165.

AS/NZS 1. 2005. Occupational noise management. Sydney/Wellington.

Aybek A, Kamer H. 2010. Personal noise exposures of operators of agricultural tractors. Applied Ergonomics , 274-291.

Barbeau E, Roelofs C. 2004. Assessment of occupational safety and health programs in small businesses. American Journal of Industrial Medicine , 371-379.

Barrenäs M, Holgers M. 2000. A clinical evaluation of the hearing disability and handicap scale in men with noise induced hearing loss. Noise Health.

Bilbao. 2007. Assessing, reducing and eliminating risk at source. European Agency for Safety and Health at Work.

Canetto P. 2007. Occupational noise reduction practices. First European Forum on Efficient Solutions for Managing Occupational Noise Risks.

Cheesman M, Steinberg P. 2010. Health Surveillance for noise induced hearing loss. Occup Med , 576-577.

Directive. 2003/71/EC. minimum health and safety requirements regarding the exposure of workers to the risks arising from physical agents (noise).

ECs/E/.2004. Hearing protectors—recommendations for selection, use, care and maintenance guidance document.

Girard M, Picard M. 2004. Work-related accidents associated with noise-induced hearing loss and noisy. World Conference on Injury Prevention and Safety Promotion.
Hahn S. 2008. A short scale for measuring safety climate. Safety Science , 1047-1066.
Hannah L. 2004. Sound and the Restaurant Environment. McGraw-Hill .
Hong S, Samo D. 2008. Perception and Attitudes of Firefighters on Noise Exposure and Hearing Loss. Journal of Occupational and Environmental Hygiene , 210-215.
Ide C. 2007. Hearing loss, accidents, near misses and job losses in firefighters. Occup. Med , 203-209.
McBride D, David I. 2003. Noise Exposure and Hearing Loss in Agriculture. Journal of Occupational and Environmental Medicine , 1281-1288.
Mohammadi G. 2008. Hearing conservation programs in selected metal fabrication industries. Applied Acoustics , 287-292.
Reinhold K. 2009. Hazards profile in manufacturing: determination of risk levels towards enhancing workplace safety. Environmental Engineering and Landscape Management , 69-80.
Toppila E, Pyykkö I. 2009. Evaluation of the Increased Accident Risk From Workplace Noise. International Journal of Occupational Safety and Ergonomics , 155-162.