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Potential Health Effects of Noise Among Plant Workers at Aluminum Industry in Dubai, UAE

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Abstract

Background: It is estimated that about 600 million workers are exposed to workplace noise worldwide. The WHO estimates that approximately 15% of the workers in developed countries are exposed to noise levels which are harmful to hearing. *Objectives*: To study some of potential health hazards among plant workers at aluminum industry due to exposure to worksite noise. *Methodology*: A cross sectional study was conducted in Dubai Aluminum Company Limited (DUBAL). All workers in DUBAL were targeted in the study. The sample size was calculated by using computer program EPI-Info version "6.04". The sample size was 400 workers with 100% response rate. Stratified random sampling technique was used. Two groups were selected according to noise level exposure. An interview questionnaire was designed for collection of data. *Results*: Plant workers showed significantly higher blood pressure level than administration group whether systolic (127.37 + 12.01 mmHg and 123.85 + 15.13 mmHg respectively) or diastolic (81.92 + 8.85 mmHg and 79.66 + 9.75 mmHg respectively). The two groups also differ significantly in the mean total cholesterol level (203.62 + 38.52 mmHg and 189.08 +32.94 mmHg respectively) and LDL (134.2 + 36.71 and 122.58 + 35.67 respectively). There was significantly higher pulse rate among the high exposure group (77.37 + 15.02 beats/min) than among the moderately high exposure group (72.47 + 13.82 beats/min) and the low exposure group (70.21 + 11.96 beats/min). *Conclusions*: Headache and pulse rate were related to the level of noise exposure at work site. Blood pressure (systolic and diastolic), total cholesterol and low density lipoprotein were all related to the place of work. Injury at work site was higher among workers exposed to noise compared with the administration departments with an apparent higher frequency of injury among workers in areas with high level of noise exposure in contrast to the low noise exposure category. *Recommendations*: Technical control of the problem along with admistrative control and Awareness for the workers has to be developed in an integrated health prevention and control program.

Keywords

Noise, Plant Workers, Aluminum Industry, Dubai

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1. Introduction

Noise is present in every human activity, and when assessing its impact on human well-being, it is usually classified either as occupational noise (i.e. noise in the workplace), or as environmental noise, which includes noise in all other settings, whether at the community, residential, or domestic level (e.g. traffic, playgrounds, sports, music).(1) Noise levels are measured in decibels (dB), approximately 60 dB is the level of normal talking. Exposure for more than six hours a day to sound in excess of 85 dB is potentially hazardous to health. Measurements in A-weighted dB (dB(A)) assess loudness and compensate for the human ear's lower

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sensitivity to lower frequency and very high-frequency sounds. (2)

Noise is the most pervasive hazardous agent at workplaces (3-5) and it is still the most frequent occupational hazard in workplaces. It is estimated that about 600 million workers are exposed to workplace noise worldwide. (6) The WHO estimates that approximately 15% of the workers in developed countries are exposed to noise levels which are harmful to hearing. (5) Approximately 30 million American workers are exposed to hazardous noise on their jobs. (4) In most developing countries, industrial noise levels are higher than those in the developed countries. (3)

Noise has both auditory and non-auditory health effects. Although the direct physical consequence of loud noise, especially over a period of time, is hearing loss and tinnitus (auditory effect), noise at lower levels can have indirect impact on our physiological and psychological systems, that is, non-auditory effects. (2) Noise-induced hearing loss (NIHL) is one of the oldest occupational diseases (6) and is one of the most important occupational diseases arising from long-term exposure to unauthorized noise levels.(6-11) NIHL is characterized by a gradual reduction in hearing acuity because of continuous exposure to intense levels of sound pressure, causing damage to outer and inner hair cells of the Organ of Corti. (12) NIHL is measured by comparing the threshold of hearing at a specified frequency with a specified standard of normal hearing, and is reported in units of dB hearing loss. The first effects of exposure to excess noise are typically an increase in the threshold of hearing called temporary auditory threshold shift (TTS). This is defined as a change in hearing thresholds of an average 10 dB or more at 2000, 3000 and 4000 Hz in either ear. The hearing loss corresponds to a permanent increase in the threshold of hearing that may be accompanied by tinnitus. Because hearing impairment is usually gradual, the affected worker will not notice changes in hearing ability until a large threshold shift has occurred. Noise-induced hearing impairment occurs predominantly at higher frequencies (3000−6000 Hz), with the largest effect at 4000 Hz. It is irreversible and increases in primary aluminum production which is considered as one of the largest industries in the world today. According to the International Aluminum Institute, this industry directly employs over a million people worldwide and indirectly generates four times as many jobs in downstream and service industries. (13)

In all phases of aluminum production, workers are exposed to numerous chemical and physical hazards. Noise is a significant health risk in aluminum smelting and casting operations where it has been identified to exceed 90 dB(A). (3)

2. Objectives

To study some of potential health hazards among plant workers at aluminum industry due to exposure to worksite noise.

3. Methodology

A cross sectional study was conducted. The study was conducted in Dubai Aluminum Company Limited (DUBAL) which owns and operates one of the world's largest aluminum smelters. All workers in DUBAL were targeted in the study

Exclusion criteria :History of ototoxic drug use, diabetes, severe or frequent ear infections, ear trauma, conductive or sensory hearing loss with a known etiology except for noise exposure. The sample size was calculated by using computer program EPI-Info version “6.04”. the minimum expected sample size was 334. Our sample size was 400 workers with 100% response rate. Stratified random sampling technique was used. Two groups were selected according to noise level exposure: The first group (200 workers) in which the employees were classified according to the noise level exposure into three strata: Group 1: Low noise exposure : <85 dB(A), Group 2: Moderately high noise exposure: 85−<90 dB(A), and Group 3: High noise exposure: >90 dB(A). (14,15-19) An interview questionnaire was designed for collection of data. The questionnaire was reviewed by occupational and community medicine consultants to review the face and content validity.

Table (1). Noise related health problems among workers by place of work (DUBAL, 2010).

		Administation (200)		Plant (200)		P
		No.	%	No.	%	
Injury at work	Yes	7	3.5	27	13.5	0.000
	No	193	96.5	173	86.5	
Hypertention	Yes	21	10.5	19	9.5	0.739
	No	179	89.5	181	90.5	
Cardiovascular disease	Yes	2	1.0	3	1.5	0.686
	No	198	99.0	197	98.5	
Hyperlipidemia	Yes	18	9.0	15	7.5	0.586
	No	182	91.0	185	92.5	
Stress	Yes	126	63.0	106	53.0	0.043
	No	74	37.0	94	47.0	
Sleep disturbance	Yes	51	25.5	60	30.0	0.315
	No	149	74.5	140	70.0	
Otoscopic examination	Normal	200	100.0	199	99.5	1.000
	Right ear perforation	0	0.0	1	0.5	

4. Results

Some of the noise related health problems are presented in relation to place of work in table (1). Problem which is significantly higher among plant workers than administration

department workers include injury at work site (13.5% and 3.5% respectively). Stress at work was significantly lower among plant workers than administration workers (53.0% and 63.0% respectively) where other health problems do not differ significantly between the two groups.

Table (2). Potential health effects of noise among plant workers according to different levels of noise (DUBAL, 2010).

		Low (<85 dB) (66)		Moderate (85- 90 dB) (67)		High (>90 dB) (67)		P
		No.	%	No.	%	No.	%	
Annoyance with high noise at work	Yes	43	65.2	44	65.7	51	76.1	0.246
	No	23	34.8	23	34.3	16	23.9	
Headache due to noise at work	Ye	6	9.0	12	17.9	16	23.1	0.019
	No	60	91.0	55	82.1	55	76.9	
Speech interference due to noise	Yes	41	62.1	46	68.7	48	71.6	0.354
	No	25	37.9	21	31.3	19	28.4	
Injury at work site	Yes	11	16.7	4	6.0	12	17.9	0.058
	No	55	83.3	63	94.0	55	82.1	
hypertention	Yes	7	10.6	8	11.9	4	6.0	0.666
	No	59	89.4	59	88.1	63	94.0	
Cardiovascular disease	Yes	0	0.0	1	1.5	2	3.0	0.395
	No	66	100.0	66	98.5	65	97.9	
hyperlipidemia	Yes	4	6.1	7	10.4	4	6.0	0.693
	No	62	93.9	60	89.6	63	94.0	
Stress at work site	Yes	34	51.5	35	52.2	37	55.2	0.229
	No	32	48.5	32	47.8	30	44.8	
Sleep disturbance	Yes	16	24.2	22	32.8	22	32.8	0.451
	No	50	75.8	45	67.2	45	67.2	

When plant workers are stratified by level of noise exposure (table 2), no significant difference was encountered except the significantly higher percentage of those complaining of headache due to noise at the high exposure level 23.9% than the moderately high (17.9%) and low (9.0%). Otherwise there is just an apparent higher frequency of injury at work site (17.9%) among the high exposure group in contrast to the low exposure category (16.7%).

Table (3) demonstrates the results of clinical examination of workers by place of work. Plant workers showed significantly higher blood pressure level than administration group whether systolic (127.37 + 12.01 mmHg and 123.85 + 15.13 mmHg respectively) or diastolic (81.92 + 8.85 mmHg and 79.66 + 9.75 mmHg respectively). The two groups also differ significantly in the mean total cholesterol level (203.62 + 38.52 mmHg and 189.08 + 32.94 mmHg respectively) and LDL (134.2 + 36.71 and 122.58 + 35.67 respectively). Other measurements did not differ significantly though they are apparently higher among the plant group than the administration group.

Table (3). Results of clinical examination and investigations of workers by place of work (DUBAL, 2010).

	Administration (200)	Plant (200)	P
	Mean (SD)	Mean (SD)	
Systolic blood pressure (mmHG)	123.85 (15.13)	127.37 (12.01)	0.005
Diastolic blood pressure (mmHG)	79.66 (9.75)	81.92 (8.85)	0.015
Pulse rate (beat\minute)	71.43 (11.98)	73.36 (13.91)	0.338
Total cholesterol	189.08 (32.94)	203.62 (38.52)	0.044
HDL	45.10 (14.24)	42.56 (10.17)	0.600
LDL	122.58 (35.67)	134.2 (36.71)	0.027
Triglycerides	117.7 (78.57)	133.94 (80.54)	0.117

However when theses health effects were compared among plant workers with different levels of exposure (table 4), no significant difference between groups was encountered except the significantly higher pulse rate among the high exposure group (77.37 + 15.02 beats/min) than among the moderately high exposure group (72.47 + 13.82 beats/min) and the low exposure group (70.21 + 11.96 beats/min). Other

measurements showed just apparent higher levels among the high noise exposure group than the other two groups as systolic, diastolic blood pressure, total cholesterol, LDL and triglycerides.

Table (4). Results of clinical examination and investigations of plant workers by noise exposure level (DUBAL, 2010).

	Low (<85 dB) (66)		Moderate (85- 90 dB) (67)		High (>90 dB) (67)		P
	Mean	SD	Mean	Sd	Mean	SD	
Systolic blood pressure (mmHG)	126.11	10.98	126.94	13.16	129.03	11.76	0.325
Diastolic blood pressure (mmHG)	81.10	9.53	82.06	8.34	82.58	8.73	0.868
Pulse rate (beat\minute)	70.21	11.96	72.47	13.82	77.37	15.02	0.022
Total cholesterol	193.50	29.11	198.57	37.43	212.32	43.77	0.294
HDL	43.28	10.31	42.24	10.96	41.86	7.78	0.869
LDL	126.94	27.21	132.57	38.37	139.88	42.26	0.479
Triglycerides	116.94	73.29	121.29	35.84	149.72	92.55	0.339

5. Discussion

It was evinced that plant workers have significantly about 2.56 times the risk of developing hearing loss compared to administration workers with prevalence of 8.5% among plant workers and 3.5% among administration workers. In accordance with the definition of NIHL, (20,21,22,23) this finding can serve reliably the assumption that hearing loss among plant workers can be attributed to noise exposure at work site. Reputing the differences between this study compared to others regarding the criteria used for defining hearing impairment, yet, the prevalence rate of hearing impairment reported in the current study is comparable to those reported by other researchers who found prevalence rate ranging between 8.59 % and 59.7 %. (4, 22,24,25,26) In a study done by Chang et al., (2009) (24) that assessed the exposure levels of noise among male workers in a liquefied petroleum gas cylinder infusion factory, it was found that the hearing threshold for each frequency tested was significant between groups, especially for the frequencies at 4 k, 6 k, and 8 kHz. Seixas et al., Apart from noise induced hearing loss, many other health problems likely to be associated with exposure to noise at work site were studied as well. First of these health problems, was headache. When plant workers are stratified by level of noise exposure, a significant difference was encountered. Higher percentage of those complaining of headache due to noise was found at the high exposure level than at the moderately high and at low noise exposure level. Headache was proved to be a common non auditory deleterious health effect among workers exposed to noise at work site by many researchers. (27-29)

On the contrary, stress at work was significantly lower among plant workers than among administration workers. Wieclaw et al., (2006) (30) in their study found a consistent association between employment in human service occupations and the risk of affective and stress related disorders. On the contrary, Melchior et al., (2003) (31) found that, job stress is most prevalent among manual workers and office clerks and predicts the occurrence of sickness absence. Annoyance, speech interference and sleep disturbances displayed non-significant relations with the development of NIHL among workers exposed to noise. In a study about noise exposure in oil mills, Kumar, (2008) (32) concluded that as a subjective response, 63% of his study sample expressed that noise was interfering with their conversation during work and subsequently harmed their hearing. Jakovljevic et al., (2006) (33) in a study about sleep disturbance in relation to noise exposure detected that, noise annoyance, subjective noise sensitivity and neuroticism were significantly correlated with difficulties with falling asleep, time needed to fall asleep, poorer sleep quality, tiredness after sleep, and use of sleeping pills.

Some physical findings were also investigated in relation to noise level exposure as well as the development of NIHL. Pulse rate was significantly related to noise level exposure, where it was more rapid among the high noise exposure group than among the moderately high exposure group and the low exposure group. This finding revealed an agreement with the results of Salameh, (2005) (34) and Powazka et al., (2002) (35) who proved positive correlation between the noise level exposure and pulse rate among workers in their studies.

Regarding some other physical findings, it was concluded that plant workers had significantly higher blood pressure level (systolic and diastolic), higher mean total cholesterol level, higher LDL level and apparently higher triglycerides comparing with the workers in administration group. Based on noise level exposure, it was found that, all these parameters revealed just apparent higher levels among the high noise exposure group than among the other two groups. In their study, Zhao et al., (2009) (36) reported that noise exposure is a significant determinant of hypertension prevalence, but third in order of importance behind family history of hypertension and salt use.

Our results came in accordance with others who proved an

association between noise exposure and hypertension. Salameh (2005) (34) concluded that high levels of noise pollution can affect adversely the blood pressure (systolic and diastolic). Raised blood pressure among workers exposed to noise at work was also reported by other researchers; Stanbury et al., (2008), Haralabidis et al., (2008) Lee et al., (2009) (37-39). However, Rizk and Sharaf, (2010) (40) in their study to assess the risk of hearing loss among a sample of fermentation plant workers in Egypt exposed to both noise and a mixture of organic solvents have reported no association between blood pressure and exposure to noise. Moreover, Janghorbani et al., (2009) (41) found that blood pressure had no significant independent association with noise-induced hearing.

Considering blood cholesterol, Standbury et al., (2008) (37) in their study that assessed the prevalence of self-reported hearing loss and work-related noise-induced hearing loss in Michigan found an association between noise exposure and elevated cholesterol. While Janghorbani et al., (2009)(41) reported no association between noise exposure and raised cholesterol and triglyceride. Also, work site injuries were marked with noise exposure. Where proved to be higher among plant workers exposed to noise compared to administration group, also an apparent higher frequency of work site injuries were reported among the high noise level exposure group in contrast to the low exposure category. A study was done to assess occupational noise as a risk factor for work-related injuries showed that, "work always exposed to high-level noise" and "work sometimes exposed to high-level noise" were associated with relative high risk for work-related injuries compared with “work with no noise”. Based on these findings, the study concluded that, investing in hearing conservation programs, particularly those for controlling noise emission at its source, is justifiable aiming at both hearing health maintenance and reduction of work-related injuries.(42) Melamed et al., (2004) (43) in their study to explore the possibility that exposure to noise at work might interact with job complexity to affect the incidence of occupational injury among industrial employees, found that the joint exposure to noise and high job complexity is disruptive, resulting in higher distress and occupational injury risk, particularly among women.

Explicitly we can brief that exposure to high levels of noise can cause different types of health problems that might be auditory in the form of hearing loss or non-auditory effects. Using many sensible approaches, noise exposure at work site could be preventable and controllable hazard. As a sobering step, continuous monitoring of noise level as well as raising the alertness to detect signs of hearing loss or other manifestations are important measures. By virtue of these steps, our trials would give way to assuage the deleterious effects of noise exposure, these steps would serve reliably to keep workers healthy and certainly would be heralded with good productivity.

6. Conclusions

Headache and pulse rate were related to the level of noise exposure at work site. Blood pressure (systolic and diastolic), total cholesterol and low density lipoprotein were all related to the place of work. Injury at work site was higher among workers exposed to noise compared with the administration departments with an apparent higher frequency of injury among workers in areas with high level of noise exposure in contrast to the low noise exposure category.

Recommendations

Technical control of the problem along with admistrative control and Awareness for the workers has to be developed in an integrated health prevention and control program.

References

[1] Concha-Barrientos M C., Campbell-Lendrum D. Steenland K. Occupational noise: Assessing the burden of disease from work-related hearing impairment at national and local levels. Environmental Burden of Disease Series, No. 9. World Health Organization. Protection of the Human Environment. Geneva. 2004.

[2] Ana G R, Shendell D G, Brown GE, Sridhar1 M K. Assessment of Noise and Associated Health Impacts at Selected Secondary Schools in Ibadan, Nigeria. Journal of Environmental and Public Health. 2009.(2009): 1-6 [cited 2010 Jan 10]. Available from: http://www.hindawi.com/journals/jeph/2009/739502.html.

[3] Doko-Jelinic J , Lukic J, Udovicic R, Zuskini E, Nola I A, Zajec Z. Workplace noise exposure after modernization of an aluminium processing complex. Arh Hig Rada Toksikol. 2009;60:343-348.

[4] Pouryaghoub G, Mehrdad R, Mohammadi S. Interaction of smoking and occupational noise exposure on hearing loss: a cross-sectional study. BMC Public Health 2007; 7:137: 1-5

[5] Dias A, Cordeiro R. Association between hearing loss level and degree of discomfort introduced by tinnitus in workers exposed to noise. Rev Bras Otorrinolaringol.2008;74(6):876-883

[6] Attarchi M S, Labbafinejad Y, Mohammadi S. Contemporary exposure to cigarette smoke and noise of automobile manufacturing company workers. J Public Health. 2010;18(3):245-249

[7] Babisch W. Guest Editorial: Noise and Health. Environmental Health Perspectives. 2005;113 (1): A 14-A15

[8] Mizoue T, Miyamoto T, Shimizu T. Combined effect of smoking and occupational exposure to noise on hearing loss in steel factory workers. Occup Environ Med 2003;60:56–59

[9] Kock S, Andersen T, Kolstad H A , Kofoed-Nielsen B , Wiesler F, Bonde J P. Surveillance of noise exposure in the Danish workplace: a baseline survey. Occup Environ Med 2004;61:838–843

[10] Palmer K T, Griffin M J, Syddall H E, Davis A, Pannett B, Coggon D. Occupational exposure to noise and the attributable burden of hearing difficulties in Great Britain. Occup Environ Med. 2002;59:634–639

[11] Seixas N S, Goldman B, Sheppard L, Neitzel R, Norton S, Kujawa S G. Prospective noise induced changes to hearing among construction industry apprentices. Occup Environ Med. 2005;62:309–317

[12] Boger M E, Barbosa- Branco A, Ottoni U C. The noise spectrum influence on Noise-Induced Hearing Loss prevalence in workers. Braz J Otorhinolaryngol. 2009;75(3):328-334

[13] International Aluminium Institute (IAI). The aluminium industry's sustainable development report. [displayed 9 April 2009, cited 2010 March 4]. Available from: http://www.world-aluminium.org/cache/fl0000107.pdf

[14] Ahmed H O, Dennis J H, Badran O, Ismail M, Ballal S G, Ashoor A, Jerwood D. Occupational Noise Exposure and Hearing Loss of Workers in Two Plants in Eastern Saudi Arabia. Ann occup Hyg. 2001;45(5):371-380

[15] Hessel P A, Sluis G K. Hearing loss in white South African goldminers. South African Medical Journal. 1987;71:364-367

[16] Hernandez-Gaytan S I, Santos-Burgo A C, Becker-Meyer J P, Macias-Carrillo C, Lopez-Cervantes M. Prevalence of hearing loss and correlated factors in a cement plant. *Salud Publica de Mexico*, *Public Health of Mexi* .2000; 42(2):106– 111

[17] Shaikh G H. Noise problem in a polyester fiber plant in Pakistan. *Industrial Health.*1996 ;34:427–431

[18] Osibogun A, Igweze I A, Adeniran L O. Noise-induced hearing loss among textile workers in Lagos Metropolis. *The Nigerian Postgraduate Medical Journal.2000*; 7(3):104–111

[19] Sriwattanatamma P, Breysse P . Comparison of NIOSH noise criteria and OSHA hearing conservation criteria. *American Journal of Industrial Medicine.2000;*37:334–338.

[20] Yildirimi I, Kilinc M, Okur E, Tolun F I, Kilic M A, Kurutas E B, Ekerbcer H C. The effects of noise on hearing and oxidative stress in textile workers. Industrial Health. 2007; 45:743–749

[21] Krishnamurti S. Sensorineural Hearing Loss Associated with Occupational Noise Exposure: Effects of Age-Corrections. Int. J. Environ. Res. Public Health. 2009; 6:889-899

[22] Gidikova P, Prakova G, Ruev P, Sandeva G. Hearing impairment among workers occupationally exposed to excessive levels of noise. Central European Journal of Medicine.2007;2(3):313–318

[23] Al-Otaibi S T. Occupational hearing loss. Saudi Medical Journal 2000; 21 (6): 523-530

[24] Chang S, Chang C. Prevalence and Risk Factors of Noise-induced Hearing Loss among Liquefied Petroleum Gas (LPG) Cylinder Infusion Workers in Taiwan. Industrial Health. 2009; 47:603–610

[25] Gomes J, Lloyd O, Norman N. The health of the workers in a rapidly developing country: effects of occupational exposure to noise and heat. Occupational Medicine. 2002;52(3):121-128

[26] Ahmed H O, Dennis J H, Badran O, Ismail M, Ballal S G, Ashoor A, Jerwood D. Occupational Noise Exposure and Hearing Loss of Workers in Two Plants in Eastern Saudi Arabia. Ann occup Hyg. 2001;45(5):371-380

[27] Singh L P, Bhardwaj A, Deepak K K, Bedi R. Occupational Noise Exposure in Small Scale Hand Tools Manufacturing (Forging) Industry (SSI) in Northern India. Industrial Health. 2009; 47: 423–430.

[28] Bin W S, Richardson S, Yeow P H. An ergonomics study of a semiconductors factory in an IDC for improvement in occupational health and safety. Int J Occup Saf Ergon. 2010;16(3):345-356.

[29] Mahendra P M, Sridhar V. The relationship between noise frequency components and physical, physiological and psychological effects of industrial workers. Noise Health. 2008;10(40):90-98.

[30] Wieclaw J, Agerbo E, Mortensen P, Bonde J. Risk of affective and stress related disorders among employees in human service professions. Occup Environ Med.2006;63(5): 314–319.

[31] Melchior M, Niedhammer I, Berkman L F, Gold-berg M. Psychosocial work factors, social relations, and sickness absence: a 6-year prospective study of the GAZEL cohort. J Epidemiol Community Health. 2003; 57:285–293.

[32] Kumar G V, Dewangan K N, Sarkar A. Noise exposure in oil mills. Indian J Occup Environ Med. 2008;12(1): 23–28.

[33] Jakovljevic B, Belojevic G, Paunovic K, Stojanov V. Road Traffic Noise and Sleep Disturbances in an Urban Population: Cross-sectional Study. Croat Med J. 2006;47:125-133.

[34] Salameh A I. Effects of Occupational Noise Exposure on Blood Pressure, Pulse Rate, and Hearing Threshold Levels of Workers in Selected Industrial Plants in Jenin City, Palestine. [Master Thesis] An-Najah National University, Nablus, Palestine. 2005.

[35] Powazka E, Pawlas K, Zahorska-Markiewicz B, Zejda J El. A crosssectional study of occupational noise exposure and blood pressure in steelworkers. Noise & Health.2002; 5: 15-22.

[36] Zhao Y, Zhang S, Selvin S, Spear R C. A dose-response relationship for occupational noise-induced hypertension. Br J Ind Med. 2009;88:189-207.

[37] Stanbury M, Rafferty A P, Rosenman K. Prevalence of hearing loss and workrelated noise-induced hearing loss in Michigan. J Occup Environ Med. 2008;50(1):72-79.

[38] Haralabidis A S, Dimakopoulou K, Vigna-Taglianti F. Acute effects of nighttime noise exposure on blood pressure in populations living near airports. European Heart Journal .2008;29:658–664.

[39] Lee J H, Kang W, Yaang S R, Choy N, Lee C R,: Cohort study for the effect of chronic noise exposure on blood pressure among male workers in Busan, Korea. Am J Ind Med. 2009; 52(6):509-517.

[40] Rizk S A , Sharaf N E. Health hazards among a sample of workers exposed to a combination of noise and organic solvents in a fermentation factory in Egypt. Nature and Science. 2010;8(6):95-99.

[41] Janghorbani M, Sheikhi A, Pourabdian S. The Prevalence and Correlates of Hearing Loss in Drivers in Isfahan, Iran. Arch Iranian Med. 2009; 12 (2): 128 – 134.

[42] Cordeiro R, Clemente A P, Diniz C S, Dias A. Occupational noise as a risk factor for work-related injuries. Rev. Saúde Pública.2005;39 (3):461-466.

[43] Melamed S, Fried Y, Froom P. The joint effect of noise exposure and job complexity on distress and injury risk among men and women: the cardiovascular occupational risk factors determination. J Occup Environ Med. 2004 ;46(10):1023-32.