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The Interaction of Noise Pollution and Blood Pressure in a Textile Factory in Ilam, Iran

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ABSTRACT

The aim of the present study was to assess the industrial noise pollution and its effects on the blood pressure of workers during activities in textile factory in Ilam,which is situated in west of Iran. A cross-sectional study was performed on a group included 81 workers and 30 people as sample and control group, respectively. A questionnaire was filled out and then the other measurements including the total sound pressure level, weight, height, pulse, blood pressure and all the rest of medical examinations have been respectively done. The average sound pressure level measured for sample and control group was respectively (94.86 ±6.63) and (61.93 ± 4.56) dBA. The result also showed that by taking mean values for each quantitative variable, statistically only the age has significant difference between opposing groups. Sound frequency analysis in A and C networks over a frequency range between 125 to 16000 Hz revealed a significant differences in such away that sound pressure level for the sample group was higher than the limited threshold (85 dBA). Moreover, the results from the survey of the total sound pressure level in A –and C – weighted according to blood pressure status, BMI and age indicate a significant statistical correlation between the mentioned variables. A highly significant correlation was found by χ^2 test between the level of sound pressure, blood pressure status, BMI and the age group in different octave band center frequencies. It is concluded that planning for working hours of workers to decrease the noise exposure and employment of young workers with appropriate BMI may reduce the adverse effects of noise.

Keywords: *Blood pressure, Industrial activities, Noise pollution*

INTRODUCTION

Noise is one of the many stressors people have to cope with in their everyday lives, especially in the developed countries, where the models of social and economical organization, the technological development and the growth of population are key factors in the increase of noise pollution [1, 2].

Indeed, noise pollution has been recognized as a serious health hazard [3]. Noise-related health hazards cause damage to humans ranging from annoyance to insanity and death [4]. Noise-induced sleeping problems and their influence on mood and performance the next day are part of every normal life. However, at some point, sleeping problems or sleep disturbance may become clinically significant as normal physical, mental, and social functioning are hampered. Furthermore, an effect such as the elevation of blood pressure caused by noise exposure might fall largely within normal homeostasis [5]. Long term noise-induced stress may lead to disturbance of blood pressure regulation through the raise of circulatory stress hormones: adrenaline, noradrenaline [6]. On the other hand, an increase in blood pressure may also induce in the prevalence and mortality of cardiovascular disease [7].

Noise-related disorders have been identified in exposed workers and have led to the concept of vibro-acoustic disease (VAD). Investigation of VAD prevalence is of particular importance in workers of industries where noise prevails (e.g., airplane and textile plants) [8].

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Table 1. Values (percentage and abundance distribution) of blood pressure among workers by studied groups

Parameter		Sample group		Control group	
		number	percentage	number	percentage
Systolic blood pressure	Normal (≤ 140)	72	88.9	29	67-96
	Borderline (141 – 159)	8	9.87	-	-
	Hypertension(≥ 160)	1	1.23	1	33-36
Total		81	100	30	100
Diastolic blood pressure	Normal (≤ 140)	73	90.12	29	96.7
	Borderline (141 – 159)	7	8.64	1	36.33
	Hypertension(≥ 160)	1	1.24	-	-
Total		81	100	30	100

Table 2. Mean and abundance distribution of quantitative variables among workers by studied groups

Variable			Number	Mean	Standard deviation	F	P	T	D*f*	P	Result
Age		1 S *	81	30.57	6.7	3.1	0.082	2.21	72.87	0.03	S
		2 C**	30	28.03	4.76						
Number of children		1 S	81	0.827	1.28	4.62	0.034	1.4	109	0.16	NS
		2 C	30	0.416	0.93						
Working history		1 S	81	6.97	4.22	1.72	0.19	0.82	61.54	0.42	NS
		2 C	30	6.26	3.53						
Work duration in previous job		1 S	81	0.45	1.34	0.93	0.33	482	45.66	0.63	NS
		2 C	30	0.6	1.56						
Work duration except the main job		1 S	81	6.17	0.55	14.07	000	-1.8	109	0.07	NS
		2 C	30	0.668	2.85						
Smoking (behavior)		1 S	81	1.62	4.85	3.54	0.06	1.66	96.63	0.24	NS
		2 C	30	0.80	2.53						
Smoking history		1 S	81	1.50	4.12	1.02	3.14	1.66	61.96	0.6	NS
		2 C	30	1.10	3.42						
Smoking history		1 S	81	1.22	3.10	0.004	0.94	0.03	51.74	0.97	NS
		2 C	30	1.2	3.11						
Medical history of family		1 S	81	24.12	3.74	0.62	0.43	0.9	62.09	0.37	NS
		2 C	30	23.57	3.1						
Systolic blood pressure		1 S	81	117.72	18.09	1.44	0.23	0.69	64.26	0.49	NS
		2 C	30	115.4	14.51						
Diastolic blood pressure		1 S	81	78.49	7.64	4.19	0.04	3.26	0.1	0.001	S
		2 C	30	73.55	5.21						
Height		1 S	81	176.48	6.55	0.04	0.83	1.54	46.09	0.12	NS
		2 C	30	174.06	7.56						
Weight		1 S	81	75.46	10.61	0.06	0.80	1.47	44.96	0.14	NS
		2 C	30	71.63	12.66						
Sound pressure level	dBA	1 S	81	94.86	6.63	0.76	0.38	24.71	109	000	S
		2 C	30	61.93	4.56						
	dBC	1 S	81	98.36	6.1	0.21	0.64	25.56	109	000	S
		2 C	30	67.03	4.56						
Frequency	125	1 S	81	81.25	8.10	21.49	000	23.57	109	000	S
		2 C	30	51.1	2.36						
	250	1 S	81	88.39	9.42	22.59	000	20.71	109	000	S
		2 C	30	52.1	2.73						
	500	1 S	81	89.27	9.2	5.93	0.01	22.89	109	000	S
		2 C	30	50	4.68						
	1000	1 S	81	90.54	9.03	7.71	0.006	23.73	109	000	S
		2 C	30	49.2	4.96						
	2000	1 S	81	90.55	9.03	25.29	000	21.24	109	000	S
		2 C	30	51.06	4.96						
	4000	1 S	81	90.93	9.96	2.71	000	21.03	109	000	S
		2 C	30	40.36	3.20						
	8000	1 S	81	90.93	9.48	38.32	000	24.52	109	000	S
		2 C	30	40.36	1.68						
	16000	1 S	81	88.31	9.29	49.22	000	24.89	109	000	S
		2 C	30	45.76	1.45						

*Sample group = S
* *Control group = C

To gain more insight into the relation between noise exposure and its potential health impact, a descriptive-

analytical investigation was conducted in order to estimate the interactive effect of noise pollution on blood pressure among the workers of a textile factory.

MATERIALS AND METHODS

A cross sectional study was conducted on 111 subjects from a textile factory in Ilam which is situated in west of Iran. The sample group included 81 workers who were exposed to a noisy environment and were

Table 3. Percentage and abundance distribution of sample group according to frequency, sound pressure level dBA, BMI, and blood pressure status

Frequency	BMI	< 19		19-27 (Normal)						> 27							
	Blood pressure	Systolic < 140& Dia-stolic < 90		Systolic < 140 & Dia-stolic < 90		Systolic 140 – 159 & Diastolic < 90		Total		Systolic < 140& Dia-stolic < 90		Systolic 140 - 159& Dia-stolic < 90		Systolic > 160 & Dia-stolic < 90		Total	
	Sound pressure level	N	P	N	P	N	P	N	P	N	P	N	P	N	P	N	P
125	< 84	1	33.3	14	22.5	-	-	14	22.5	2	12.5	-	-	-	-	2	12.5
	85-99	2	66.7	47	75.8	1	1.6	48	77.4	7	43.7	5	31.2	2	12.5	14	87.5
	Total	3	100	61	98.3	1	1.6	62	100	9	56.2	5	31.2	2	12.5	16	100
250	< 84	1	33.3	14	22.5	-	-	14	22.5	2	12.5	-	-	-	-	2	12.5
	85-99	2	66.7	47	75.8	1	1.6	48	77.4	7	43.7	5	31.2	2	12.5	14	87.5
	Total	3	100	61	98.3	1	1.6	62	100	9	56.2	5	31.2	2	12.5	16	100
500	< 84	1	33.3	14	22.5	-	-	14	22.5	2	12.5	-	-	-	-	2	12.5
	85-99	2	66.7	47	75.8	1	1.6	48	77.4	7	43.7	5	31.2	2	12.5	14	87.5
	Total	3	100	61	98.3	1	1.6	62	100	9	56.2	5	31.2	2	12.5	16	100
1000	< 84	1	33.3	14	22.5	-	-	14	22.5	2	12.5	-	-	-	-	2	12.5
	85-99	2	66.7	47	75.8	1	1.6	48	77.4	7	43.7	5	31.2	2	12.5	14	87.5
	Total	3	100	61	98.3	1	1.6	62	100	9	56.2	5	31.2	2	12.5	16	100
2000	< 84	1	33.3	14	22.5	-	-	14	22.5	2	12.5	-	-	-	-	2	12.5
	85-99	2	66.7	47	75.8	1	1.6	48	77.4	7	43.7	5	31.2	2	12.5	14	87.5
	Total	3	100	61	98.3	1	1.6	62	100	9	56.2	5	31.2	2	12.5	16	100
4000	< 84	1	33.3	14	22.5	-	-	14	22.5	2	12.5	-	-	-	-	2	12.5
	85-99	2	66.7	47	75.8	1	1.6	48	77.4	7	43.7	5	31.2	2	12.5	14	87.5
	Total	3	100	61	98.3	1	1.6	62	100	9	56.2	5	31.2	2	12.5	16	100
8000	< 84	1	33.3	14	22.5	-	-	14	22.5	2	12.5	-	-	-	-	2	12.5
	85-99	2	66.7	47	75.8	1	1.6	48	77.4	7	43.7	5	31.2	2	12.5	14	87.5
	Total	3	100	61	98.3	1	1.6	62	100	9	56.2	5	31.2	2	12.5	16	100
16000	< 84	1	33.3	14	22.5	-	-	14	22.5	2	12.5	-	-	-	-	2	12.5
	85-99	2	66.7	47	75.8	1	1.6	48	77.4	7	43.7	5	31.2	2	12.5	14	87.5
	Total	3	100	61	98.3	1	1.6	62	100	9	56.2	5	31.2	2	12.5	16	100
spl	< 84	1	33.3	14	22.5	-	-	14	22.5	2	12.5	-	-	-	-	2	12.5
	85-99	2	66.7	47	75.8	1	1.6	48	77.4	7	43.7	5	31.2	2	12.5	14	87.5

randomly selected. In addition, 30 workers who were exposed to lower sound pressure level were also introduced as a control group. The questionnaire consisted of two segments. The first part comprised general demographic data and the second part consisted of technical questions such as systolic and diastolic blood pressure. The questionnaire also included the sound pressure level over different frequencies. Based on similar surveys, expert opinions and statistical tests such as Half split method and test – retest, validity and reliability of the questionnaire was confirmed ($\alpha = 0.85$).

In two stages, systolic and diastolic blood pressure was measured by a medical doctor and nurses. At first, each worker was examined by a physician and then, after the subject had been supine for 15 – 20 min, blood pressure was measured 3 times in 5 min intervals. In a second experimental session, the above examination was carried out by another person. In the same condition, for each worker pulse rate was counted by radial artery palpitation for 1 min.

With regard to exposure to noise in the studied area and from a noise-mapping study, sampling sites were selected for detailed investigation. At each site, the measurements of the total sound level and sound analysis in 1/3 octave band frequencies was carried out. To illustrate the accuracy levels of the noise, the procedure was applied different times a day and night at each of the selected measurement sites. Noise level was measured using a sound level meter type B&K 2230, made in Denmark. The data were statistically tested by T- test.

RESULTS

The highest sound pressure level for sample group 104 dBA were recorded in the welding while the lowest noise levels 79.95 dBA were recorded on the twisted bobbins. The results also indicated that the entire control group was estimated under maximum sound pressure of 61.93 dBA. According to the variables of sound pressure level estimated in A and C-weighted, mean sound pressure level in sample group and control group was 94.86 ± 4.63 dBA and 61.93 ± 4.56 dBA, respectively which shows statistically a significant difference among the subjects.

Table 1 shows systolic and diastolic blood pressure of the workers. It shows that based on WHO definition, 88.9% of the sample group have a normal blood pressure, 8.64% have a borderline blood pressure and 2.47% have hypertension. On the contrary, the blood pressure for control group subjects was 96.7 % with normal blood pressure and 3.3 with hypertension.

From sample and control group, we found differences in mean of quantitative variables such as age, working history, work duration in previous job, work duration except the main job, smoking (behavior), height, weight, a history of smoking, medical history of family and number of children were statistically insignificant while, from age changes there was a statistical significant difference between sample group (30.57±6.17) and control group (28.03±4.76), (P=0.03, df=109 and t=2.21). In addition, by performing t- test a

Table 4. Percentage and abundance distribution of control group according to frequency, sound pressure level dBA, BMI, and blood pressure status

fre-quency	BMI	< 19		19-27 (Normal)						> 27	
	Blood pressure	Systolic < 140 & Diastolic < 90		Systolic < 140 & Diastolic < 90		Systolic 140 – 159 & Diastolic < 90		Total		Systolic < 140 & Diastolic < 90	
	Sound pressure level	N	P	N	P	N	P	N	P	N	P
125	< 84	1	3.8	24	92.3	1	3.8	96.3		4	100
	85-99	-	-	-	-					-	-
	Total	1	3.8	24	92.3	1	43.8	25	100	4	100
250	< 84	1	3.8	24	92.3	1	3.8	96.3		4	100
	85-99	-	-	-	-					-	-
	Total	1	3.8	24	92.3	1	43.8	25	100	4	100
500	< 84	1	3.8	24	92.3	1	3.8	96.3		4	100
	85-99	-	-	-	-					-	-
	Total	1	3.8	24	92.3	1	43.8	25	100	4	100
1000	< 84	1	3.8	24	92.3	1	3.8	96.3		4	100
	85-99	-	-	-	-					-	-
	Total	1	3.8	24	92.3	1	43.8	25	100	4	100
2000	< 84	1	3.8	24	92.3	1	3.8	96.3		4	100
	85-99	-	-	-	-					-	-
	Total	1	3.8	24	92.3	1	43.8	25	100	4	100
4000	< 84	1	3.8	24	92.3	1	3.8	96.3		4	100
	85-99	-	-	-	-					-	-
	Total	1	3.8	24	92.3	1	43.8	25	100	4	100
8000	< 84	1	3.8	24	92.3	1	3.8	96.3		4	100
	85-99	-	-	-	-					-	-
	Total	1	3.8	24	92.3	1	43.8	25	100	4	100
16000	< 84	1	3.8	24	92.3	1	3.8	96.3		4	100
	85-99	-	-	-	-					-	-
	Total	1	3.8	24	92.3	1	43.8	25	100	4	100

significant difference in age variable could be observed (t = 2.21, df =109 and P =0.000).

With respect to the association between noise and blood pressure, in mean systolic blood pressure no significant differences between the mentioned groups could be noticed. How ever, in mean diastolic blood pressure significant difference were evident (t = 3.262, df = 109 and P = 0.001) (Table 2). Furthermore, by the use of t-test the results showed that diastolic blood pressure had differences between sample and control groups (P= 0.000, df= 109 and t=3.262).The results from sound pressure level, BMI and blood pressure level showed that subjects with BMI more than 27 and noise exposure of (85-99 dBA), had borderline blood pressure and hypertension respectively 7.5 % and 2.9 % (Table 3 and 4). Moreover, the chi-squared test showed significant correlation between sound pressure level, BMI, and blood pressure status (P=0.000, df= 4and $\chi^2 = 25.54$).

As shown in Table 5 and 6, there was a significant relation between sound pressure level, BMI, blood pressure status and age at the test frequencies (P = 0.000, df= 4 and $\chi^2 = 23.29$). Investigation from a noise level of 85 -99 dBA showed that the workers under the age of 29 had normal blood pressure and from workers with a age within the age group of 30-44 years 82.86 % had normal blood pressure, 14.28 % border line blood pressure and 2.86 % hypertension. However, only 50 % of workers over the age of 45 years had normal blood pressure and the rest of them equally had borderline pressure and hypertension.

The association between blood pressure status, sound pressure level and age was statistically significant (χ^2 = 13.62, df = 4 and P = 0.0009) while among blood pressure status, sound pressure level and work history in the range of eight frequencies no significant statistical relation were detected.

DISCUSSION

The present study was consistent with the report of Mahmood et al., (2007) [10] who noted that there was a significant rise in blood pressure in response to noise. The findings listed above are in agreement with the results of the other studies in the literature [7]. They indicate that, the group of workers which are exposed to lep, d (lep, d = personal daily levels of exposure (assuming an 8-hr shift)), greater than 90 dBA had a higher mean diastolic BP and a higher frequency of diastolic hypertension than those exposed at lower noise levels. Exposure to occupational noise above 85 dBA is also reported to associate with elevated ambulatory blood pressure in male workers aged from 20 to 50 years [9, 10, 11, 12].

This study carried out an analysis of the environmental noise exposure on blood pressure in workers of a textile factory. From WHO definition, blood pressure status of sample and control groups showed that normal blood pressure of sample and control groups were respectively 88.9 % and 96.7 %. In addition, the prevalence of sample group with hypertensive and borderline values of blood pressure was 2.47% and 8.64%, respectively. In addition to systolic/ diastolic blood pressure changes, t–test stated a significant difference in diastolic blood pressure among studied groups. In other words, sample group which are exposed to higher sound pressure, have increased diastolic blood pressure.

Table 5. Percentage and abundance distribution of sample group according to frequency, sound pressure level dBA, age, and blood pressure status

frequency	Age	≤ 29				30-44						≥ 45							
	Blood pressure	Systolic < 140& Diastolic < 90		Systolic < 140 & Diastolic < 90		Systolic 140 – 159 & Diastolic < 90		Systolic > 160 & Diastolic < 90		Total		Systolic < 140& Diastolic < 90		Systolic 140 - 159& Diastolic < 90		Systolic > 160 & Diastolic < 90		Total	
	Sound pressure level	N	P	N	P	N	P	N	P	N	P	N	P	N	P	N	P	N	P
125	< 84	13	30.9	4	11.4	-	-	-	-	4	11.4	-	-	-	-	-	-	-	-
	85-99	29	69	25	71.4	5	14.2	1	2.8	31	88.5	2	50	1	25	1	25	4	100
	Total	42	100	29	82.8	5	14.2	1	2.8	35	100	2	50	1	25	1	25	4	100
250	< 84	13	30.9	4	11.4	-	-	-	-	4	11.4	-	-	-	-	-	-	-	-
	85-99	29	69	25	71.4	5	14.2	1	2.8	31	88.5	2	50	1	25	1	25	4	100
	Total	42	100	29	82.8	5	14.2	1	2.8	35	100	2	50	1	25	1	25	4	100
500	< 84	13	30.9	4	11.4	-	-	-	-	4	11.4	-	-	-	-	-	-	-	-
	85-99	29	69	25	71.4	5	14.2	1	2.8	31	88.5	2	50	1	25	1	25	4	100
	Total	42	100	29	82.8	5	14.2	1	2.8	35	100	2	50	1	25	1	25	4	100
1000	< 84	13	30.9	4	11.4	-	-	-	-	4	11.4	-	-	-	-	-	-	-	-
	85-99	29	69	25	71.4	5	14.2	1	2.8	31	88.5	2	50	1	25	1	25	4	100
	Total	42	100	29	82.8	5	14.2	1	2.8	35	100	2	50	1	25	1	25	4	100
2000	< 84	13	30.9	4	11.4	-	-	-	-	4	11.4	-	-	-	-	-	-	-	-
	85-99	29	69	25	71.4	5	14.2	1	2.8	31	88.5	2	50	1	25	1	25	4	100
	Total	42	100	29	82.8	5	14.2	1	2.8	35	100	2	50	1	25	1	25	4	100
4000	< 84	13	30.9	4	11.4	-	-	-	-	4	11.4	-	-	-	-	-	-	-	-
	85-99	29	69	25	71.4	5	14.2	1	2.8	31	88.5	2	50	1	25	1	25	4	100
	Total	42	100	29	82.8	5	14.2	1	2.8	35	100	2	50	1	25	1	25	4	100
8000	< 84	13	30.9	4	11.4	-	-	-	-	4	11.4	-	-	-	-	-	-	-	-
	85-99	29	69	25	71.4	5	14.2	1	2.8	31	88.5	2	50	1	25	1	25	4	100
	Total	42	100	29	82.8	5	14.2	1	2.8	35	100	2	50	1	25	1	25	4	100
16000	< 84	13	30.9	4	11.4	-	-	-	-	4	11.4	-	-	-	-	-	-	-	-
	85-99	29	69	25	71.4	5	14.2	1	2.8	31	88.5	2	50	1	25	1	25	4	100
	Total	42	100	29	82.8	5	14.2	1	2.8	35	100	2	50	1	25	1	25	4	100

Considering that using *t*- test, no significant differences were found in quantitative variables (e.g. working history, work duration in current job, work duration except the main job, smoking (behavior), height, weight, a history of smoking and medical history of family among subjects, Thus, it can be concluded that the mentioned variables were relatively harmonious.

However, *t*- test showed considerable difference in

Table 6. Percentage and abundance distribution of control group according to frequency, sound pressure level dBA, age, and blood pressure status

frequency	Age	≤ 29						30-44						≥ 45					
	Blood pressure	Systolic < 140 & Diastolic < 90		Systolic > 160 & Diastolic < 90		Total		Systolic < 140& Diastolic < 90		Systolic > 160 & Diastolic < 90		Total		Systolic < 140& Diastolic < 90		Systolic 140 - 159& Diastolic < 90		Total	
	Sound pressure level	N	P	N	P	N	P	N	P	N	P	N	P	N	P	N	P	N	P
125	< 84	18	94.7	1	5.2	19	100	11	100	-	-	-	-	-	-	-	-	-	-
	85-99	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Total	18	94.7	1	5.2	19	100	11	100	-	-	-	-	-	-	-	-	-	-
250	< 84	18	94.7	1	5.2	19	100	11	100	-	-	-	-	-	-	-	-	-	-
	85-99	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Total	18	94.7	1	5.2	19	100	11	100	-	-	-	-	-	-	-	-	-	-
500	< 84	18	94.7	1	5.2	19	100	11	100	-	-	-	-	-	-	-	-	-	-
	85-99	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Total	18	94.7	1	5.2	19	100	11	100	-	-	-	-	-	-	-	-	-	-
1000	< 84	18	94.7	1	5.2	19	100	11	100	-	-	-	-	-	-	-	-	-	-
	85-99	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Total	18	94.7	1	5.2	19	100	11	100	-	-	-	-	-	-	-	-	-	-
2000	< 84	18	94.7	1	5.2	19	100	11	100	-	-	-	-	-	-	-	-	-	-
	85-99	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Total	18	94.7	1	5.2	19	100	11	100	-	-	-	-	-	-	-	-	-	-
4000	< 84	18	94.7	1	5.2	19	100	11	100	-	-	-	-	-	-	-	-	-	-
	85-99	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Total	18	94.7	1	5.2	19	100	11	100	-	-	-	-	-	-	-	-	-	-
8000	< 84	18	94.7	1	5.2	19	100	11	100	-	-	-	-	-	-	-	-	-	-
	85-99	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Total	18	94.7	1	5.2	19	100	11	100	-	-	-	-	-	-	-	-	-	-
16000	< 84	18	94.7	1	5.2	19	100	11	100	-	-	-	-	-	-	-	-	-	-
	85-99	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Total	18	94.7	1	5.2	19	100	11	100	-	-	-	-	-	-	-	-	-	-

the mean age of these two groups (P= 0.03). From the point of view of sound analysis, three types of trends can be distinguished at the range of frequencies. From 125 to 4000 Hz sound pressure level demonstrates upward trend while at frequency of 16000 Hz an opposite trend has been observed. Moreover, this trend at frequency 8000 Hz is in constant which the maximum difference of sound pressure level from that frequency range was 3.6 dBA.

With regard to the mean sound pressure level, *t*- test shows a significant difference in A- and C- weighted (P= 0.000). This approach indicates that sample group is exposed to higher sound pressure than that of the control one. From the sound analysis results in octave band (8 frequencies), it can be observed that the sample group is exposed to higher sound pressure level, which shows a heterogeneous working environment among these two groups.

CONCLUSION

As a conclusion the following suggestions could be useful for further investigations:

1-Appropriate selection of machines with a good maintenance

2-Planning for working hours of workers to decrease the sound pressure exposure

3-Employment of young workers with appropriate BMI

4-Further research on relation of sound and blood pressure in industrial environments on young adults.

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