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The Effects of Noise Pollution on Arterial Blood Pressure and Heart Pulse Rate of Doctors in their Dental Offices

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Abstract: ***This study reports the relationship between occupational noise levels with arterial blood pressure (systolic and diastolic), and heart pulse rate for dentists in their offices chosen randomly in Jenin City. The noise levels measured during operational periods in the chosen dental offices were found to be between 90.5 and 91.7 dB. The arterial blood pressure (systolic and diastolic) and heart pulse rate of doctors were measured before and after exposure to noise for four hours. Positive correlation (Pearson Correlation Coefficient) with noise pollution was found for all measured variables. The mean blood pressure, for examples, has Pearson's Coefficient R = 0.629 for systolic and R = 0.475 for diastolic. In addition, heart pulse rate has a Pearson's Coefficient R = 0.560. This study shows that after four hours of work, there is a significant increase in the mean measured values of blood pressure (systolic and diastolic) and heart pulse rate. The mean of systolic blood pressure, for example, is increased by 4.4 mm-Hg, while the mean of diastolic blood pressure is increased by 3.8 mm-Hg. Finally, the heart pulse rate mean is increased by 3.6 beats/minute.***

Keywords: Systolic, Diastolic, pearson Correlation Coefficent.

1. Introduction

In order to minimize the effect of noise on human's attitude and health, many studies were conducted investigating the impact of noise in several places throughout the world. In dental offices, for example, several researches were done dealing with the equipments used and their effects on blood pressure, heart pulse rate, hearing threshold and tinnitus (1-3). A study dealt with the question of whether dentists are at greater risk than others (4). The result of that study insures that 67% of dentists should use hearing protection because dental hand pieces were emitting noise levels that could cause hearing loss. Other studies have shown significant correlation between noise and its impact on artery disease including systolic and diastolic blood pressure (5), cholesterol concentration and plasma viscosity **(**6, 7). In Palestine, some studies concerning noise and its effects on humans were done. For example, the sound pressure level was measured in some factories in Nablus and Jenin cities (6, 8, 9). Moreover, efforts were made to investigate the impact of noise on children in some schools (10). It was shown that noise produces changes in systolic and diastolic blood pressures and heart pulse rate. This study have been initiated in order to gain more insight about noise levels and its effects on dentists' blood pressures and heart pulse rates as they work in their offices.

2. Methodology

Data collection was carried out in the selected dental offices during morning hours (between 9:00 a. m and 13:00 p. m), during the period from January to May 2012. The microphone of sound level meter was placed at a 15cm distance from the dentist's ear in order to capture sounds at the intensity they influence the operator's ears. The level of the noise was measured while the instrument was at different running speeds every 40 second, and arterial blood pressure and heart pulse rate were taken every 30 minute.

Sound Pressure Levels (SPL)

The sound pressure level values in all selected dental offices were measured during four continuous hours (9:00 a. m – 13:00 p. m). The mean values of those noise levels were calculated every five minutes and are shown in Fig. (1). It is clear from the figure that the mean values fluctuate around 91 dB with no significant change as a function of time. However, the measured values are considered to be high according to OSHA standards (11).

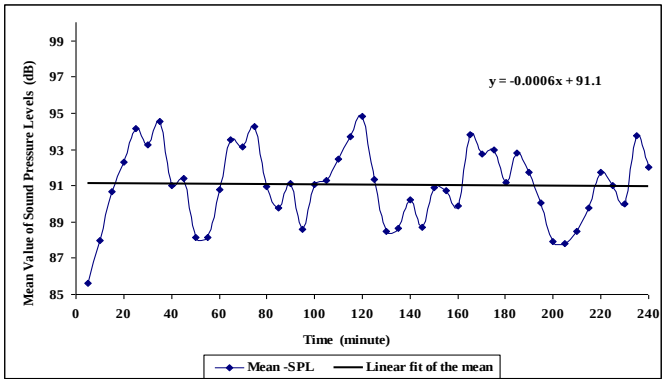

Figure (1):
The mean sound pressure levels and best linear fit of the mean as a function of time in all selected dental offices.

Two remarks are obvious from this figure:

1- The mean of SPL was 91.1 dB. The measured values are considered to be high according to OSHA.

2- It is noticed that the peak value of SPL was around eleven o'clock which is the rush hour (after 120 minute from starting measurements).

Results of Arterial Blood Pressure (Systolic and Diastolic)

Systolic and diastolic blood pressure (SBP and DBP) during working hours for doctors (9:00 a. m – 13:00 p. m), in all selected dental offices, were measured and recorded (table (4.1)). The doctor's genders, ages, and serving years were also recorded.

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Table (1):

Doctor's genders, ages, and their serving year and the measured values of systolic and diastolic blood pressure during working hours (9:00 a.m – 13:00 p.m) for doctors, in all selected dental offices.

Gender	Age (year)	Number of serving years (year)	Systolic Blood Pressure Before Work mm-Hg	Systolic Blood Pressure During Work (mm-Hg)								Diastolic Blood Pressure Before Work mm-Hg	Diastolic Blood Pressure During Work (mm-Hg)							
			9: 0 a.m	9:30 a.m	10:00 a.m	10:30 a.m	11:00 a.m	11:30 a.m	12:00 noon	12:30 p.m	13:00 p.m	9:0 a.m	9:30 a.m	10:00 a.m	10:30 a.m	11:00 a.m	11:30 a.m	12:00 noon	12:30 p.m	13:00 p.m
			Sys	Sys	Sys	Sys	Sys	Sys	Sys	Sys	Sys	Dia	Dia	Dia	Dia	Dia	Dia	Dia	Dia	Dia
M	24	2	125	126	128	132	134	136	138	139	140	81	85	87	88	88	89	89	90	90
M	26	3	126	128	129	130	131	134	136	137	139	83	85	86	87	87	87	88	89	89
F	29	4	126	128	130	136	140	140	141	142	143	82	81	82	86	89	90	90	91	91
M	30	5	125	127	134	137	140	141	143	143	145	75	78	81	82	86	87	88	90	90
M	32	6	124	128	133	137	140	140	141	143	144	78	79	86	87	88	88	90	90	91
F	36	10	128	133	133	140	141	145	148	150	150	78	84	84	85	88	91	93	93	94
M	38	11	130	134	136	140	145	146	150	151	151	85	87	88	88	91	94	95	97	98
M	41	13	125	131	138	142	144	147	149	150	151	83	87	90	94	95	96	97	98	98
F	42	15	130	137	139	143	146	147	149	150	151	75	82	85	88	89	91	93	94	95
M	43	17	138	138	139	141	144	152	154	156	156	85	88	88	90	92	101	103	103	104
M	45	20	125	130	132	138	140	142	146	150	153	78	81	86	87	90	94	98	99	100
F	47	21	135	140	144	146	149	150	152	153	154	88	89	90	93	90	93	97	97	99
M	53	27	138	138	139	141	144	152	154	156	156	85	88	88	90	92	101	103	103	104
M	55	28	124	135	138	139	143	145	147	147	151	78	88	85	91	92	93	98	99	100
M	60	30	125	135	137	139	144	149	153	155	157	88	89	90	90	94	99	100	100	101

Some points can be summarized from table (1):

1- There is a significant increase in the measured values of systolic blood pressure and diastolic blood pressure of all selected doctors before and while exposure to noise during all working hours figures (2 and 3). This increase might be due to being exhausted after working for long time or due to being exposed to noise for long time. However this factor is studied in more details as will be shown later.

2- The degree of increment is different from one doctor to another, due to some personal factors like doctor ages and serving duration.

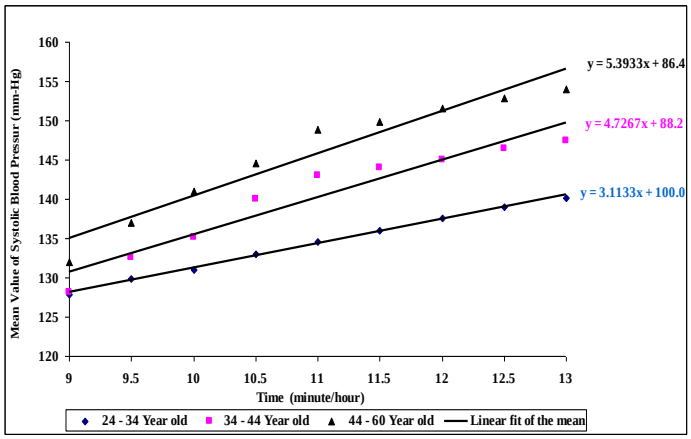

Figure (2):

The rate of increase and best linear fit of the mean value of systolic blood pressure for every 30 minutes of different group's ages.

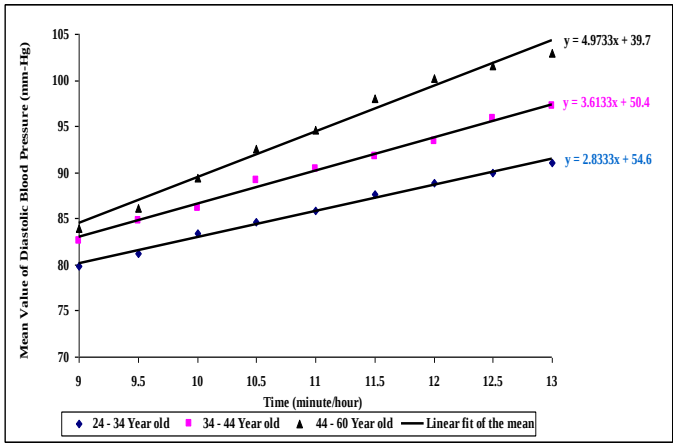

Figure (3):

The rate of increase and best linear fit of the mean value of diastolic blood pressure for every 30 minutes of different group's ages.

The data of sound pressure levels, systolic and diastolic blood pressure have been analyzed using the program (SPSS) software. A positive correlation (Pearson Correlation Coefficient) (R) was found between the mean sound pressure levels and the systolic and diastolic blood pressures table (2).

Table (2):

Place	Number of Doctors	M-SPL	Dependant variables	R	Sig P-value
Selected dental offices	15	91.1	SBP	0.629	0.002
			DBP	0.475	0.04

Pearson correlation coefficients between sound pressure level and arterial blood pressure (SBP and DBP) in all selected dental offices.

The Pearson Correlation Coefficient (R) for all variables is > 0.475, and P-value for all variables is < 0.050, which means strong positive correlation appeared between all studied variables in all selected dental offices

3. Results of Heart Pulse Rate

Measurements of heart pulse rate to all selected doctors have been performed while under exposure to noise in their dental offices. The results of the data are given in table (3).

Systolic and Diastolic Data Analysis

Table (3):

Heart Pulse Rate (beats / minute)																The average values for all doctors
Time (min.)	D_1	D_2	D_3	D_4	D_5	D_6	D_7	D_8	D_9	D_{10}	D_{11}	D_{12}	D_{13}	D_{14}	D_{15}	
9:00 (a. m)	68	70	67	69	71	74	71	74	71	72	75	77	73	72	77	**72.2**
9:30 (a. m)	70	72	73.5	72.7	73.3	74.6	74	75	75	74	77	81	78	73.6	78.3	**75.6**
10:00 (a.m)	73.6	75.4	74.6	74	75.8	77.2	78	77.9	78.1	76.2	80	83	80	80.6	87.3	**78.5**
10:30 (a.m)	74.3	78	77.3	76.6	78	78	82	79.3	79	80.3	81	84	85.3	93.6	89.5	**80.6**
11:00 (a.m)	77.2	78.6	80	79.6	79.9	80	82	81	81.3	82.6	82.2	89	87.9	94.3	91.8	**82.6**
11:30(a.m)	78	79	81.1	81.7	82	82.6	83	82	83.6	83	85	89	90.5	94.9	95	**84.2**
12:00 (noon)	79.5	80.9	82	82	82.3	83.3	83	83.6	84.9	87	86.6	90	94.3	95.1	95.8	**85.3**
12:30(p.m)	80.4	81.6	82.6	82.9	83	83.6	84	84.7	86	87.3	87	90	94.2	95.9	96.4	**86.2**
13:00(p.m)	81.8	81.9	83	84.4	84.9	84.1	85	85.3	88	88.6	87.6	91	95	96.3	96.9	**87.1**
$\overline{D_i}$	**76**	**78**	**78**	**78**	**79**	**80**	**80**	**80**	**81**	**81**	**82**	**86**	**87**	**89**	**90**	

The values (D_1-D_{15}) and mean values ($\overline{D_i}$) of heart pulse rate in (beats/minute) of all selected doctors as a function of exposure time during the work (9:00 a. m – 13:00 p. m).

Table (3) shows the following points:

1- A positive increase of heart pulse rate of all doctors as a function of time. This increasing reaches its maximum at 13:00 o'clock. This is might be of the long time that doctors exposed to noise from the instrumentation used in their dental offices.
2- The increment of heart pulse rate is different from one doctor to another, and this difference might be due to some factors like doctor ages and serving duration.

Heart Pulse Rate Data Analysis

The data of heart pulse rate has been analyzed using the program (SPSS) software. A positive correlation (Pearson Correlation Coefficient) was found between independent variables, mean sound pressure levels and dependent variables (heart pulse rate)**.** In the same table (4), significant effect of the (heart pulse rate) was detected by P- value ($P < 0.05$).

Table (4):

Pearson correlation coefficients between sound pressure level in dB and heart pulse rate in beats/minute in all selected dental offices.

Place	Number of Doctors	M-SPL (dB)	Dependant variable	R	Sig P-value.
Selected dental offices	15	91.1	HPR	0.56	0.002

The Pearson Correlation Coefficient (R) for all variables is > 0.560, and P-value for all variables is < 0.050, which gives strong relation between the dependant variable (heart pulse rate) and independent variable (sound pressure level).

A. Conclusion

As a conclusion there are a lot of methods, which can be used to reduce noise pollution to acceptable levels. Some of them are technical while others are administrative. There are many recommendations and actions may be carried on to reduce or prevent the occupational noise problem in order to minimize the noise effect of the noise on doctors in their dental offices including:
1- Using a hearing protection device when exposed to noisy dental equipment.
2- Dental drills should be kept far away from the ears of doctors.
3- The hand pieces should be well maintained, since low maintenance of the equipments increases noise intensity.
4- Dental offices walls should be covered with sound absorbing materials.
5- Reducing the exposure time of the doctors
6- The daily work schedule should be planned in certain intervals in the use of dental tools, thus limiting the acoustic trauma to shortest possible time period.

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