EFFECT OF 90 DECIBEL NOISE OF 4000 HERTZ ON BLOOD PRESSURE IN YOUNG ADULTS

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Background: Almost every individual dislikes excessive and unnecessary noise. Noise exerts various adverse psychological and physiological effects, on human body including a rise in blood pressure. Methods: 117 volunteer medical students, aged 18-23 years were exposed to 90 decibel noise of 4000 hertz for 10 minutes, produced by audiometer in a sound-proof room. Blood pressure was recorded every three minutes. Results: Blood pressure increased during exposure to noise. Average rise in systolic blood pressure was 2.462±0.532 mm Hg and average rise in diastolic blood pressure was 3.064± 1.047mm Hg. Blood pressure came to resting value within two minutes after stopping exposure to noise in more than 50% of the subjects. Conclusion: Systolic and diastolic blood pressure increases due to noise exposure.

Key Words: Noise, Blood pressure, Health

INTRODUCTION

Some authors have defined noise as any audible acoustic energy that adversely affects the physiological or psychological well being of the people.[1] The term noise is commonly used to describe sounds that are disagreeable or unpleasant produced by acoustic waves of random intensities and frequencies.[2]

Noise has become a very important "stress factor" in the environment of man.[3] Noise has many effects on exposed population.[4] The blood pressure can increase during exposure to noise and a number of pituitary hormones are affected by noise.[5] The adverse behavioral effects of noise include annoyance, interference with performance and efficiency, interference with communication and fatigue.[6] High noise levels are associated with higher accident rates.[6,7] There is positive association of noise with increased risk of threatened or spontaneous abortion, pregnancy induced hypertension, abnormal labour and low birth weight.[8] A number of temporary physiological changes occur in human body as a direct result of noise exposure. These are a rise in intra-cranial pressure, an increase in heart rate and an increase in sweating.[3] Auditory effects of noise exposure include:(a) Auditory fatigue: It appears in the 90 dB region and is greatest at 4000 Hz; it may be associated with side effects such as whistling and buzzing in the ears (b) Deafness: The hearing loss may be temporary or permanent. Most temporary loss occurs in frequency range between 4000 to 6000 Hz.[3]

Against this background, some noise experts have investigated the acute effects of short-term loud noise on blood pressure and other cardiovascular parameters. Most of the studies have shown a rise in systolic and/or diastolic blood pressure[9-20] while some of the research scientists observed negative (decreased or non-significantly increased) association between blood pressure and noise.[13,15,21,22]

Green et al[13] observed a significant increase in systolic and diastolic blood pressure in younger age group (25-44 years) subjects exposed to more than 85 dB noise as compared to decrease in systolic blood pressure and no effect on diastolic blood pressure in subjects aged 45-65 years.

As little or no work has been done on effects of noise on blood pressure in Pakistan, moreover the effect observed by other scientists is controvercial, therefore we designed this study to observe the effect of exposure to short-term noise on systolic blood pressure, diastolic blood pressure, mean arterial pressure and pulse pressure.

MATERIAL AND METHODS

117 volunteer normotensive medical students (61 male and 56 female), aged 18-23 years were exposed to 90 dB sound of 4000 Hz for 10 minutes, produced by audiometer in sound-proof audiometry room of ENT department,

Khyber Teaching Hospital, Peshawar under supervision of an expert audiologist. Procedure was explained to them and consent was taken. Inclusion criteria were: Resting heart rate between 60-100, resting systolic and diastolic blood pressure between 100-125 and 60-90mm Hg, respectively and normal auditory acuity as tested by audiometer. Ten subjects were anxious/phobic about the procedure of the test and were excluded from the study. In 16 subjects blood pressure increased during control experiment i.e. when they were exposed to experimental conditions for 10 minutes, without exposure to noise; these subjects were also excluded from study.
Blood pressure and heart rate was measured at regular three-minute intervals before, during and after the production of noise. Results were analyzed by SPSS package by using student t-test and Chi-square test. The subjects selected for the study were themselves control group by exposing them to experimental conditions, without production of noise.

Results

Statistical analysis of the data showed that the systolic blood pressure, diastolic blood pressure, pulse pressure, and mean arterial pressure increased in 57.26%, 70.94%, 34.19% and 73.50% of the total subjects, respectively; while the pulse pressure decreased in 44.44% of the total subjects showing more effect on diastolic blood pressure as compared to systolic blood pressure. The number of subjects in whom the blood pressure increased, decreased or was not affected is shown in table 1.

Table-1: Number of Subjects in whom blood pressure was affected by noise

Parameters	Increase	Decrease	No Effect
Systolic Blood Pressure	67 (57.26%)	24 (20.51%)	26 (22.22%)
Diastolic Blood Pressure	83 (70.94%)	14 (11.96%)	20 (17.09%)
Pulse pressure	40 (34.19%)	52 (44.44%)	25 (21.37%)
Mean Arterial Pressure	81 (69.23%)	24 (20.51%)	12 (10.26%)

Quantitative analysis of rise in blood pressure showed that average rise in systolic blood pressure was 2.460±0.711 mm Hg (Maximum rise: 23 mm Hg, $P < 0.05$); Average rise in Diastolic Blood Pressure was 3.064±1.047 mm Hg (Maximum rise: 27 mmHg, $P<0.05$); Average fall in pulse pressure was 0.429±0.054 mm Hg ($P > 0.05$) and average rise in Mean Arterial pressure was 2.157±0.699 mmHg (Maximum rise: 21,$P < 0.05$) (Table 2).

When the blood pressure was analyzed only in those subjects in whom the blood pressure increased, it was seen that the average rise in systolic blood pressure and diastolic blood pressure was 5.61±1.334 mmHg and 6.71±1.765 mm Hg respectively.

Moreover, once the blood pressure was increased, it came back to normal resting value within 11 minutes, except in only 3 subjects (blood pressure was not recorded after 11 minutes); in more than 50% of the subjects it took not

more than two minutes. Average blood pressure at different time intervals during exposure to noise and after exposure to noise is shown in Table-3.

Discussion

Noise pollution is a serious problem but recognition of the problem is not universal. It is increasingly being recognized as a physical factor in the environment that is injurious to many aspects of health.

Table-2: Quantitative Analysis of rise in Blood Pressure

Subjects	**SBP (mm Hg)**	**DBP (mm Hg)**	**PP (mm Hg)**	**MAP (mm Hg)**
Max. Rise (M)	19	27	13	21
Max. Rise (F)	23	20	18	19
Max. Fall (M)	15	23	17	18
Max. Fall (F)	15	2	22	2
Average Rise (M)	2.285±0.601	2.765±0.989	-0.34±0.012	2.568±0.702
Average Rise (F)	2.640±0.711	3.739±1.234	-0.562±0.056	1.827±0.639
Average Rise (Both Sexes)	2.462±0.532	3.064±1.047	-0.429±0.054	2.157±0.699

M=Male, F=Female, Max=Maximum

Table -3: Time taken by the blood pressure to come to basal level.

	No. of subjects	**2 Min.**	**5 Min.**	**8 Min.**	**11 Min.**	**> 11 Min.**
SBP	57	35(61.4%)	15(26.31%)	4(7.02%)	1(0.57%)	2(3.51%)
DBP	83	52(62.65%)	23(27.71%)	6(7.23%)	1(1.2%)	1(1.20%)
PP	↑ 40	20(50%)	10(25%)	7(17.5%)	1(2.5%)	2(5%)
	↓ 52	35(67.31%)	10(19.23%)	4(7.69%)	2(3.85%)	1(1.77%)
MAP	86	56(65.12%)	24(27.9%)	3(2.49%)	1(1.16%)	2(1.92%)

Many research scientists in the world have observed a significant rise in blood pressure in response to noise.[5,9-20] Some of the scientists observed a rise only in systolic blood pressure[12, 19] ,while many others found a significant increase in both systolic and diastolic blood pressure in response to noise.[5,9-11,13-18,20]

Regecova[14] studied the effect in children and proved that their blood pressure increases in response to even more than 60dB noise. Green et al[13] observed positive and significant association in younger age group and negative association in older age group. While on the other hand Babish et al[16] could not see any association of noise and blood pressure, but the same author in another study[17] observed decreased in diastolic blood pressure in response to noise exposure. Eliuse et al[22] observed insignificant increase in blood pressure.

Our result showed a significant rise in both systolic and diastolic blood pressure on exposure to noise for 10 minutes. The blood pressure came back to the resting value within 11 minutes in more than 95 % of the subjects in whom it increased.

The actual mechanism for increase in blood pressure is not yet completely understood but a few facts are known:there is increased 8 hour overnight urinary cortisol in children living in noisy environment,[19] peripheral vascular resistance increases and baroreceptor sensitivity is not suppressed during noise exposure[20] and there is

increased urinary excretion of epinephrine, nor-epinephrine and dopamine is subjects exposed to high levels of noise. [21]

Therefore because of limitations in exposure characteristics, adjustment for important confounders and the occurrence of publication bias further studies are suggested in this regard. [22]

Finally, in order to prevent or at least minimize the health hazards due to noise exposure, it is recommended that maximum allowable duration of
exposure to noise should be reviewed and strictly followed; legislation for control of noise should be constituted and strict policy be adapted to enforce the concerned laws.

Efforts should be made to control the noise at the source, to control the transmission of noise and to protect the exposed persons; there should be permanent arrangements for regular measurements of noise levels at different locations in cities and factories and health education regarding noise control should be given due importance.

Conclusion

Noise is increasingly being recognized as a physical factor in the environment that is injurious to health. One of the ill effects of noise on human body is rise in blood pressure. In our study short-term exposure to noise for 10 minutes produced a significant rise in blood pressure. Both systolic and diastolic blood pressure increased but the rise in diastolic blood pressure was more than the rise in systolic blood pressure.

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