Original Research Article

Effect of noise pollution on cardiovascular profile of power loom workers

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Abstract

Background: Textile industry is one of such industry where the risk of development of noise induced hazards is very high. Most of the studies shows that persistent noise stress increases the risk of cardiovascular disorders which include hypertension and ischemic heart disease. **Aim:** The present study was intended to evaluate the influence of noise exposure on cardiovascular profile of the workers in textile factories in Ahmedabad. **Method and Material:** The study is an observation case control study with age and socioeconomic class matched 40 subjects working in power loom factories and 40 subjects people working in low noise area. Heart rate, blood pressure and lipid profile were estimated in both the groups to assess the effect of noise on cardiovascular profile. **Result:** The results showed statistically significant increased systolic blood pressure, diastolic blood pressure, heart rate, increased total cholesterol (TC), Low density lipoprotein (LDL) and triglycerides and decreased high density lipoprotein (HDL). There was correlation with the increase in duration and increased blood pressure and dyslipidemia. The odds ratio suggested that power loom worker have 5.57 times more chances to develop borderline high Triglyceride level than those working in low noise areas. Similarly, the odds ratio for TC, HDL, and LDL was found to be 23.4, 6.33 and 8.27 respectively. **Conclusion:** To conclude these results indicate that industrial noise are a possible contributing factors in the development of arterial hypertension and other coronary risk factors as hypercholesterolemia, and hypertriglyceridemia.

Key Words: Blood Pressure, Lipid Profile, Noise Pollution, Power Loom Workers.

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INTRODUCTION

The term noise is commonly used to describe sounds that are disagreeable or unpleasant produced by acoustic waves of random intensities and frequencies[1.] The Federal Occupational safety and Health Act (OSHA) administrated by the U.S. Department of Labour, requires that specified noise exposures not be exceeded. Apart from hearing damage and community annoyance excessive noise pollution has been also found responsible for hypertension, fatigue, heart trouble, disturbed platelet count, plasma viscosity, serum lipid, triglycerides, glucose and reduced motor efficiency[2]. Many studies have shown that noise influences the cardiovascular, endocrine, metabolic, gastrointestinal and neurological systems[3]. The cardiovascular effects of noise have been the source of growing interest in the recent years. This is because of the increased evidence of noise effects on cardiovascular diseases that have a high prevalence in industrialized countries, and which are a major cause of death[4]. The cardiovascular effects of noise have been intensely explored in the last 50 years. Experiments on animals and humans were carried out, aiming to explore the basic biological mechanisms. Most of the studies shows that persistent noise stress increases the risk of cardiovascular disorders which include hypertension and ischemic heart disease.[5,6,7]. Several community noise studies showed an increased risk of high blood pressure and myocardial infarction (MI) in relation to exposure to environmental noise.[8,9,10] The long-term effects of chronic noise exposure at high noise levels have been studied in

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animals, showing permanent vascular changes and alterations in the heart muscle, which indicate an increased risk of cardiovascular mortality.[11] Although the effects tend to be diluted in the occupational studies due to the 'healthy worker effect, epidemiological studies carried out in the occupational field have shown that employees working in high noise environments are at a higher risk for high blood pressure and myocardial infarction.[12] There are many industries where the risk of development of noise induced harmful effect is very high e.g. diesel engine room, electric furnace arc, petroleum industry, newspaper press etc. Textile industry is one of such industry where the risk of development of noise induced hazards is very high as the average sound level is about 106 dB. High level of noise in workplace is very hazardous as it is sustained on a regular basis for many hours each day over many years. The present study was intended to evaluate the influence of noise exposure on cardiovascular profile of the workers in textile factories in Ahmedabad.

MATERIALS AND METHOD

The study was an observational type case control study of the people working in power loom factories and people working in low noise area in Ahmedabad city. 40 subjects who worked in vicinity of the high sound producing machines were taken as cases and 40 subjects working in low noise area were taken as control. All the subjects were workers and belonged in low socio economic class.Subjects with any family history of cardiovascular disease, addiction of alcohol smoking were excluded from the study.

Method of data collection: The data was collected by means of a personal interview by history taking, physical examination and performing the tests. An informed consent of all the participants was taken. To measure the amount of noise Sound Level Meter Model: SL-4001 from Lutron Electronic was used. The noise in power loom factory was 102-108dB and the controls were taken those persons working in noise in the range 60-75dB. A portable electronic machine (Omron Made) was used to measure Blood Pressure and Pulse. A blood sample from all the subjects was taken for lipid profile. The samples were tested for following parameters: Serum Cholesterol, Low Density Lipoprotein level, High Density Lipoprotein level and Serum Triglyceride level in gm/dl at HiTech Laboratory, Civil Hospital Ahmedabad

Statistical Analysis: The data was analyzed using Microsoft excel by applying unpaired t-test for quantitative data and using Epi Info 7 version 7.0.8.3 by chi- square test for qualitative data. Correlation coefficients and Odds ratio were calculated for the different variables. Significance level was taken as $p < 0.05$.

OBSERVATION AND RESULT

Out of 80 subjects who were studied in our study, 40 worked in a power loom factory situated in Ahmedabad and 40 worked in a handicraft factory also situated in Ahmedabad. All the workers in both the power loom factory and other factory were males. All the subjects in the study belonged to low socioeconomic class according to modified Kuppuswami classification.

Table 1: Characteristics of the study population

Characterstic	Power loom workers (PLW)	Other factory workers	p VALUE*
Age (years)	37.65±8.54	37.32±8.21	> 0.05
Height (meters)	1.622±0.04	1.625±0.04	> 0.05
Weight(kg)	64.33±8.57	64.9±9.28	> 0.05
BMI	24.39±2.63	24.57±3.46	> 0.05
Pulse (/min)	83.25±7.61	71.78±3.82	<0.05
Systolic blood pressure (SBP) (mmHg)	139.45± 9.22	124.83±4.59	<0.05
Diastolic blood pressure(DBP) (mmHg)	88.33±3.83	79.3±1.81	<0.05
Mean arterial pressure (MBP) (mmHg)	105.74±4.87	94.47±2.31	<0.05
Total Cholesterol (TC)	190.3±19.6	155.2±9.81	<0.05
HDL	38.85±3.83	44.63±1.8	<0.05
LDL	114.48±11.78	105.45±6.00	<0.05
Triglycerides	211.32±27.09	165.8±13.62	<0.05

*<0.05significant, > 0.05not significant

To study the effects of duration of occupation in power loom factory on various cardiovascular parameters linear regression analysis was applied and the F value, R^2 value, p value and correlation or Pearson's coefficient was calculated.

Table 2: Result of linear regression analysis of duration of occupation in power loom factory and various cardiovascular parameters

Parameter	F VALUE	R^2	p VALUE	Correlation Coefficient
BMI	0.23	0.006	0.63	0.078
SBP	1.46	0.037	0.23	0.19
DBP	2.44	0.060	0.12	0.24
MBP	1.77	0.044	0.19	0.21
Heart rate	0.017	0.0004	0.89	0.021
TC	25.98	0.40	9.8×10^{-6}	0.63
HDL	13.66	0.26	6.8×10^{-4}	0.51
LDL	15.20	0.28	3.8×10^{-4}	0.53
Triglycerides	10.14	0.21	2.8×10^{-3}	0.46

By applying logistic regression odds ratio and confidence interval was calculated to see the association of borderline dyslipidemia with working in power loom factory.

Table 3: Association of borderline dyslipidemia with working in power loom factory

LIPID PROFILE (mg/dl)		PLW	OTHERS	OR	CI
TG	< 150	1(2.5%)	5(12.5%)	5.57	(0.62,50.03)
	≥ 150	39(97.5%)	35(87.5%)	1	Ref
TC	< 200	25(62.5%)	39(97.5%)	23.4	(2.9,188.3)
	≥ 200	15(37.5%)	1(2.5%)	1	Ref
LDL	< 130	33(82.5%)	39(97.5%)	8.27	(0.96,70.7)
	≥ 130	7(17.5%)	1(2.5%)	1	Ref
HDL	< 45	35(87.5%)	21(52.5%)	6.33	(2.06,19.48)
	≥ 45	5(12.5%)	19(47.5%)	1	Ref

DISCUSSION

The present study is a cross sectional study of subjects in age group 25-55 years working in a power loom factory. The aim of the study was to assess the effects of noise pollution on cardiovascular profile and comparison with the subjects working in low noise area. The study showed statistically significant increase in heart rate in power loom workers as compared to 71.78±3.82 in other workers with p value was 8.9×10^{-12} suggesting the increase in heart rate can be attributed to noise pollution. Babish *et al*[13] concluded that Short-term laboratory studies carried out on humans have shown that the exposure to noise affects the sympathetic and endocrine system, resulting in acute unspecific physiological responses (e.g., heart rate, blood pressure, vasoconstriction, stress hormones, electrocardiogram (ECG) changes).[14,15]According to Goyal S *et al*[16] The higher baseline heart rate recorded in the study group is due to noise induced sympathetic response which leads to increased release of nor-epinephrine. In power loom workers the mean systolic blood pressure was found to be 139.45±9.22 as compared with the control group in whom the mean of systolic blood pressure was 124.83±4.58 with p value of 1.6×10^{-12} suggest that the difference in systolic blood pressure in two groups can be due to noise pollution. In power loom workers the increase in duration of work in power loom factory was correlated to increase in systolic blood pressure by 19 % suggesting that duration of occupation and systolic blood pressure are loosely correlated. Diastolic blood pressure was also found to be increased in the power loom workers than in other factory workers and the result was found to be statistically significant with p value equal to 3.5×10^{-19} suggesting working in noisy surrounding increases the diastolic blood pressure. In our study duration of occupation in power loomfactory has less effect on increase in diastolic blood pressure. Some of the scientists observed a rise only in systolic B.P.[17] while many others found a significant increase in both systolic and diastolic B.P. in response to noise. Babisch *et al* could not see any association of noise and blood pressure[18], whereas Elise *et al* observed insignificant increase in blood pressure[88]. The actual mechanism for increase in blood pressure is not yet completely understood but some data taken from the literature point to the following mechanism: The catecholamine's released from adrenal medulla as a result of activation of adrenergic system, the effect of suprarenal glands steroids, angiotensin and also the direct effect of noise on arterial wall tension influences the blood pressure and heart rate[19]. Stimulation by noise, through sympathetic nervous system, causes an elevation of blood pressure by an increase in total peripheral resistance and myocardial contractility[20]. The repeated stimulation with noise could then accelerate the development of structural vascular changes in the peripheral resistance of vessels and by this mechanism create a permanent blood pressure elevation to hypertensive levels[21]. According to Babisch[13]the long-term effects of chronic noise exposure at high noise levels have been studied in animals, showing permanent vascular changes and alterations in the heart muscle, which indicate an increased risk of cardiovascular mortality. Fasting lipid profile of all the subjects was done to see whether noise pollution leads to dyslipidemia. In our study the lipid profile of power loom workers suggests that working in noisy surrounding can leads to dyslipidemia and is a potential risk factor for various heart disease mainly ischemic heart disease. In the power loomworkers, the mean of total cholesterol (TC) in mg/dl was 190.3±19.6 and in control group it was 155.2 ± 9.81 with the p value 2.4×10^{-14} suggesting that the increase in the total cholesterol can be attributed to working in noisy surrounding. HDL (high density lipoprotein cholesterol) was found to be 38.85 ± 3.85 in power loom workers and 44.63 ± 1.8 in control group. HDL is good cholesterol and should be more. Low HDL suggest risk factor for development of atherosclerosis and ischemic heart disease. With p value of 3.5×10^{-12} the decrease in HDL in power loom workers can be due to their occupation. LDL (low density lipoprotein cholesterol) is termed as bad cholesterol and its increase is a risk factor for heart disease. in our study LDL in power loom and control group was 114.48 ±11.78 and105.45± 6.00 respectively. The difference was found to be statistically significant with p value 6.5×10^{-5}. Triglycerides (TG) was found to be elevated 211.32 ±27.09 in power loom workers as compared to 165.8± 13.62 in control group. With p value 2.2×10^{-13} the increase is statistically significant. To study if duration of working in power loom factory affect the lipid profile linear regression analysis was done. TC was found to be 63% correlated to duration of occupation with p value 9.8×10^{-6} suggesting high significance in result. In HDL high correlation of 51% and p value 6.8×10^{-4} suggest that with increase in duration of

occupation decrease in HDL level occurs significantly. In LDL and TG shows low predictability as compared to TC, but high correlation of 53 % and 46% suggest that increase in duration of occupation increases LDL and TG level. The p Value of 3.8×10^{-4} and 2.8×10^{-3} suggest statistical significance. Logistic regression was applied to find the association of borderline dyslipidemia with working in power loom factory. Borderline dyslipidemia was considered when Triglyceride level was ≥ 150, Total cholesterol ≥ 200, LDL ≥ 130 and HDL <45. The odds ratio suggested that power loom worker have 5.57 times more chances to develop borderline high Triglyceride level than those working in low noise areas. Similarly, the odds ratio for TC, HDL, and LDL was found to be 23.4, 6.33 and 8.27 respectively. Jovica Jovanovi *et al*[22] says that The significant more values of plasma low density lipoprotein, cholesterol and triglycerides in the noise exposed group than in the control group are considered important observations of this study because of their pathogenetic implications. These effects are compatible with the lipolytic action of adrenergic overactivity that may increase the mobilization of free fatty acids from adipose tissue and the formation of triglycerides and cholesterol, integrating the lipoproteins. These modifications in the blood lipids and the elevation of blood pressure found in this study may exert a pathogenic action on cardiovascular system, where they may accelerate atherosclerosis. Also, chronically increased blood lipids plus the direct cardiotoxic effects of epinephrine and norepinephrine can lead to coronary heart disease, degenerative changes in the myocardium and to atherosclerotic changes on arterial blood vessels of lower extremity.

CONCLUSION

Noise pollution is becoming a major public health concern with all of its potential biological and social effects on the body such as cardiovascular, hearing, performance at school and at work, and psychological. Subjects exposed to noisy work place, they must be protected by ear plugs or ear muffs and hearing assessment should be carried out time to time. To decrease noise at workplace, all machines should be properly oiled and lubricated and promote good maintenance. To conclude these results, indicate that industrial noise are a possible contributing factors in the development of arterial hypertension, myocardial infarction, angina pectoris, coronary risk factors (hypercholesterolemia, hypertriglyceridemia), atherosclerotic changes on arterial blood vessels. These results should not be neglected because our country belongs to these ones where heart diseases and diseases of blood vessels are becoming frequent causes of death.

REFERENCES

1. Akhtar HN. Noise-induced hearing loss in traffic police constables. J Coll Physicianse Surg Pak. 1996; 6(5): 265-8.
2. Regecova V, Kellerova E. Effects of Urban noise pollution on blood pressure and heart rate in preschool children. J Hypertension. 1995; 13: 405-412.
3. Anticaglia J, Cohen A. Extra-auditory effects of noise as a health hazard. Am Ind Hyg Assoc J. 1970; 31: 277-281.
4. Babisch W. Cardiovascular effects of noise. Noise Health 2011; 13:201-4.
5. Babisch W. Traffic noise and cardiovascular disease: Epidemiological review and synthesis. Noise Health 2000; 2:9- 32.
6. Van Kempen EE, Kruize H, Boshuizen HC, Ameling CB, Staatsen BA, de Hollander AE. The association between noise exposure and blood pressure and ischemic heart disease: A meta-analysis Environ Health Perspect 2002; 110:307 17.
7. Stansfeld SA, Matheson MP. Noise pollution: Non-auditory effects on health. Br Med Bull 2003; 68:243-57.
8. Bluhm GL, Berglind N, Nordling E, Rosenlund M. Road traffic noise and hypertension. Occup Environ Med 2007; 64:122-6.
9. De Kluizenaar Y, Gansevoort RT, Miedema HM, de Jong PE. Hypertension and road traffic noise exposure. J Occup Environ Med 2007; 49:484-92.
10. Jarup L, Dudley ML, Babisch W, Houthuijs D, Swart W, Pershagen G, et al. Hypertension and Exposure to Noise near Airports (HYENA): Study design and noise exposure assessment. Environ Health Perspect 2005; 113:1473- 8.
11. Ising H, Merker HJ, Günther T, Gelderblom H, Oezel M. Increase of collagen in the rat heart induced by noise. Environ Int 1979; 2:95-105.
12. Deyanov C, Mincheva L, Hadjiolova I, Ivanovich E. Study on the level of blood pressure and prevalence of arterial hypertension depending on the duration of occupational exposure to industrial noise. Cent Eur J Occup Environ Med 1995; 1:109-16.
13. Babisch W. Cardiovascular effects of noise. Noise Health 2011;13:201-4
14. Lusk SL, Gillespie B, Hagerty BM, Ziemba RA. Acute effects of noise on blood pressure and heart rate. Arch Environ Health 2004; 59:392-9.
15. Vera MN, Vila J, Godoy JF. Cardiovascular effects of traffic noise: The role of negative self-statements. Psychol Med 1994; 24:817-27.
16. F.Goyal S, Gupta V, Walia L. Effect of noise stress on autonomic function tests. Noise Health 2010; 12:182-6
17. Evans GW, lerchar P, Meis M, Ising H, Kofler WW. Community noise exposure and stress in children. J Acoust Am. 2001; 109(3): 1023-7.
18. Elise EMM, Kempen V, Kruize H Hendrick C, Boshuizen, Caroline B et al. The association between noise exposure and blood pressure and ischaemic heart disease, Environ Health prospect. 2002; 110: 307-17.
19. Andren L, Hanson L, Bjorkman M, Jonsson A. Noise as a contributing factor in the development of elevated arterial pressure. Acta Med Scand. 1980; 207: 493-498.
20. Andren L. Cardiovascular effects of noise. Acta Med Scand. 1983; 5 (Suppl 657): 1- 45.

21. Smookler HH, Geobel KH, Siegel MI,Clarke OE. Hypertensive effects of prolonged auditory, visual and mution stimulation. Fed Proc. 1973; 32: 2105- 2110.
22. Jovica Jovanovic, Vladimir Popovic, Zoran Milocevic, Milan Jovanovic Cumulative effects of communal and industrial noise on cardiovascular system The Scientific Journal FACTA UNIVERSITATIS Series: Medicine and Biology Vol.4, No 1, 1997 pp. 57 – 61.

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