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Original Research Article

Assessment of Blood Pressure Among Textile Mill Workers Exposed to Noise in Western Tamil Nadu - A Cross-Sectional Study

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ABSTRACT

Introduction: India with a population of 1.4 billion is one of the fastest growing economies with massive industrialization of all sectors. Occupational risks, such as injuries, noise, carcinogenic agents, airborne particles, and ergonomic risks results in many chronic diseases. One of the problems is noise induced cardiovascular changes. This study focuses on changes in blood pressure of the textile mill workers exposed to noise.
Aim: To assess whether blood pressure is increased in the textile mill workers when compared to that of controls.
Materials and methods: Statistically adjusted sample size of 90 participants was taken as study group. They were further categorized into Day shift workers (n=30), Night shift workers (n=30) and control group (n=30). Blood pressure was measured before the start of work and after eight hours from the start of work.
Result: The mean Systolic blood pressure between the groups, before the start of work and after eight hours from the start of work was statistically significant. But the mean diastolic blood pressure before the start of work and after eight hours from the start of work, between the groups was statistically insignificant. On correlating years of exposure with blood pressure, systolic blood pressure before start of work correlated positively in day shift workers and, systolic blood pressure before start of work and after 8 hours of work correlated positively in night shift workers.
Conclusion: So, the industrial workers should be screened for cardiovascular dysfunctions and early intervention should be done by preventive and definitive measures.

Keywords: Textile mill workers, Blood Pressure, Occupational health, Noise exposure

INTRODUCTION

Industrialization plays a major role in country's economic growth. Industrialization provides a platform for increasing the employment opportunities and helps in upscaling the people's standard of living. It also plays a major role in urbanization. But it has some disadvantages which includes environmental degradation and occupational health hazards.

In 1950, Joint International Labour Organization (ILO) / World Health

Organization (WHO) occupational health committee gave the definition of occupational health which aims at promoting and maintaining highest degree of physical, social and mental wellbeing of workers in all occupations; prevention of departure of health in workers caused by their workplace conditions; protecting the workers from risks in their employment which are adverse to health; placement and maintenance of worker adapting to his psychological and physiological capabilities in an occupational atmosphere. Occupational health includes industrial hygiene, diseases, accidents, occupation psychology, rehabilitation and ergonomics.

India with a population of 1.4 billion is one of the fastest growing economies with massive industrialization of all sectors with technological advancement and sophisticated machineries. In developing countries like India, more than half of the workers are working in the informal sector. They work with no social protection. Also they are devoid of any regulatory enforcement of occupational health and safety standards. [1]

In most countries work-related health problems contribute to about 4 – 6 % of GDP loss. In case of occupational diseases and injuries, 70% of workers do not have any proper insurance to compensate the loss.[2] Occupational risks, such as injuries, noise, carcinogenic agents, airborne particles, and ergonomic risks results in many chronic diseases. Occupational risks contribute to 37% of all cases of back pain, 16% of hearing loss, 13% of chronic obstructive pulmonary disease, 11% of asthma, 8% of injuries, 9% of lung cancer, 2% of leukemia, and 8% of depression. [2]

Workers in underdeveloped countries are more likely to be affected by hazards of high technology and huge machineries than the workers in developed countries. Due to lack of education, workers in developing countries are least aware of hazards of their work. Unemployment, cheap labour, ignorance about industrial dangers helps the employers to ignore Occupational Safety and Health (OSH).[3]

OSH is a complex empowering movement and a developmental tool in India. Lack of implementation of current legislations towards hazardous condition can lead to occupational hazards like accidents, COPD, pesticide poisoning, musculoskeletal injury and noise induced health effects. [4]Among the above occupational hazards, awareness about occupational noise induced health effect is the least.

20th century had been described as the century of noise. In the environment, noise has become an important “stress factor”. As such there is no difference between sound and noise. Sound is a sensory perception produced by complex pattern of sound waves, which may be perceived as noise, speech or music. Any unwanted sound is defined as noise.

Industrial noise is the one created in the factories which is jarring and intolerable due to running of machineries. In USA, approximately 22 million workers are exposed to hazardous noise at workplace and hearing loss is the commonest occupational injury. Noise pollution can lead to increased risk of developing hypertension

Continuous or repeated exposure to sounds at or above 80 decibels (dB) can cause noise induced hearing loss(NIHL) and other effects due to noise.[5] The risk increases at 90 dB and above in majority of individuals. [6] According to the World Health Organization estimate at least 1 million healthy life-years are lost every year from noise in Western Europe. [7]

The non auditory effects of noise pollution include disturbance and annoyance, cognitive impairment (mainly in children), sleep disturbance, and cardiovascular health impairment.[8] Persons who are exposed to long-term noise are at risk of developing hypertension. [9]

Noise is the commonest industrial pollutant. It is a major factor of occupational hazards which can be avoided. Industries like textiles, sawmill and mining are major industries exposing workers to excessive noise. In India, occupational noise exposure limit for 8 hours shift is 90 dB (A). As per studies by National Institute of Occupational Health, India, sound pressure levels (SPL) in various industries were very high. Noise levels in textile industries ranged from 102 – 114 dB(A). Although awareness about hazards of workplace noise is low among Indians, NIHL is a compensable disease since 1948 under Employees State Insurance Act. [10]

There are many studies substantiating the auditory effects of noise but only a few on non-auditory effects of noise on workers like blood pressure and stress, which may affect their overall health leading to loss of productivity. Hence the present study is done to evaluate the effect of noise on blood pressure of Textile workers.

The purpose of this study is to create an awareness among employees and employers about their occupational environment especially the hazards of noise at workplace which may pave the way for use of hearing protection equipment in these noisy environments, and prevent the workers from ill effects of noise.

AIM:

To assess whether blood pressure is increased in the textile mill workers when compared to that of controls

OBJECTIVES:

1. To estimate the systolic and diastolic blood pressure in the textile mill workers and to compare the same among the study groups.
2. To correlate the years of exposure of noise with blood pressure of the textile mill workers

MATERIALS & METHODS

This is a descriptive cross-sectional study conducted in the western district of Tamil Nadu. The participants of this study were selected from an auto loom textile mill in the western district of Tamilnadu.

This study was started after obtaining Institutional ethics clearance and written Informed consent was obtained from all the participants. Statistically adjusted sample size of 90 participants was taken as study group. They were further categorized into Day shift workers (n=30), Night shift workers (n=30) and control group (n=30). In the day shift workers group, the participants were working in the auto loom textile mill in the day shift (8 AM – 8 PM) and they were in the age group of 20-50 years. In the night shift workers group, the participants were working in the auto loom textile mill in the night shift (8PM – 8AM) and they were in the age group of 20-50 years. Working hours per shift was 12 hours per day and they were working 6 days a week. The control group was selected from the auto loom textile mill who were involved in administrative works and not exposed to high noisy environment. They were in the age group of 20-50 years.

Sound level measurement.

The noise intensity was measured using Mextech SL 4012 digital sound level meter. It is a portable instrument which can measure sound pressure levels between 30 to 130 dB(A).

The sound pressure level measured in various sections were

- Weaving - 97 dB(A)
- Sizing - 89 dB(A)
- Winding - 91 dB(A)
- Checking - 85 dB(A)
- Folding - 74 dB(A)
- Administrative Block- 59 dB(A)

Inclusion criteria:

Case Study group:

Day shift workers:

- Healthy industrial workers in age group of 20 to 50 years working 8 AM – 8 PM shift in the auto loom textile mill
- Age group of 20 – 50 years of both the gender

Night shift workers:

- Healthy industrial workers in age group of 20 to 50 years working 8 PM – 8 AM shift in the auto loom textile mill
- Age group of 20 – 50 years of both the genders

Controls:

- Clinically normal healthy individuals working in the auto loom textile mill in administrative section who were not exposed to high noisy environment
- Age group of 20 – 50 years of both genders.

Exclusion criteria.

- Age less than 20 years and more than 50 years
- Patients who are hypertensive
- Patients with known hearing impairment
- Patients with chronic diseases such as tuberculosis, chronic kidney disease, coronary artery disease, etc.
- Patients who were on medications which alter blood pressure such as Nonsteroidal anti-inflammatory drugs (NSAID), antidepressants, Immunosuppressants, Contraceptive pills, etc.

PROCEDURE

This study was conducted after giving clear instructions and explanation to all the participants. After enrolling the participants in the study, each participant was given a Unique ID and a thorough clinical examination was done. Then the socio-demographic details were collected from the participants and blood pressure was recorded.

Blood pressure was measured before the start of work and after eight hours from the start of work. The subjects were instructed to sit in a quiet room and be relaxed for about 15 minutes before measurement of blood pressure. Intake of caffeine should be avoided before 30 minutes of measurement. Subjects were seated comfortably in an armed chair with their legs uncrossed and their back and arms supported so that the middle of the cuff to be tied on the upper arm was at the level of heart. Standard mercury sphygmomanometer with a cuff size of 25x12.5 cm was used and the measurement was taken from the left arm. Three readings were taken with 5 minutes interval between them and the average of the three was taken for analysis.

STATISTICAL ANALYSIS

All data were evaluated and analysed using Statistical Package for Social Sciences (SPSS) software version 26.0. The data obtained from our study were categorical and continuous data. The categorical variables were represented in range and the continuous variables were represented as mean±SD. The normality was assessed using Kolmogorov-Smirnov test. Students' 't' test was used to compare the continuous variables between case study group and control. ANOVA (Analysis of Variance) test was used to compare the blood pressure between the day shift workers, night shift workers and the control group. Pearson's correlation test was used to correlate the years of exposure with the blood pressure (before start of work and after 8 hours of work). P value <0.05 was considered statistically significant.

RESULT

In our study, we intended to compare the blood pressure before start of work and after 8 hours of work between the case study group and the control group. The case study group was in turn classified into day shift workers and night shift workers.

Table 1: Comparison of Blood pressure before start of work and after 8 hours of work among the study group:

Comparison of Systolic blood pressure (SBP) among the study group			
Variables	**Before Start of Work Mean ± SD**	**After 8 hours Work Mean ± SD**	**'p' value**
Controls (n=30)	121.20 ± 4.92	125.67 ± 5.78	0.000*
Workers (n=60)	126.17 ± 4.22	131.17 ± 5.03	0.000*
'p' value	0.000#	0.000#	
Comparison of Diastolic blood pressure (DBP) among the study group			
Variables	Before Start of Work Mean ± SD	After 8 hours Work Mean ± SD	'p' value
Controls (n=30)	78.60 ± 5.26	81.73 ± 5.32	0.000*
Workers (n=60)	80.83 ± 3.71	85.10 ± 3.34	0.000*
'p' value	0.022#	0.000#	

SD - Standard Deviation. * p <0.05 was considered as statistically significant

The mean SBP and DBP between controls and workers showed statistically significant difference. Also, there was a significant difference in SBP and DBP before start of work and after 8 hours of work in the study group which is denoted in Table 1.

Table 2: Comparison of Systolic Blood Pressure Before Start of Work Between the Groups

Groups	**SBP Before Start of Work Mean ± SD**	**F Value**	**'p' Value**
Controls (n=30)	121.200 ± 4.916	8.75	0.032*
Dayshift (n=30)	125.800 ± 4.737		
Nightshift (n=30)	126.533 ± 3.674		

SD – Standard Deviation, * p <0.05 was considered as statistically significant

The mean SBP before start of work between the group was statistically significant as shown in table 2. In multiple comparisons, the mean difference of SBP before start of work in controls and dayshift (p=0.000) and between control and nightshift workers (p=0.000) was statistically significant, but statistically no difference was seen between dayshift and nightshift workers (p=0.802).

Table 3: Comparison of Systolic Blood Pressure after 8 Hours of work between the study groups

Groups	**SBP After 8 hours work Mean ± SD**	**F Value**	**'p' Value**
Controls (n=30)	125.667 ± 5.779	13.583	0.000*
Dayshift (n=30)	130.400 ± 5.443		
Nightshift (n=30)	131.933 ± 4.533		

SD – Standard Deviation, * p <0.05 was considered as statistically significant

The mean SBP after 8hours of work between the group was statistically significant as depicted in table 3. In multiple comparisons, the mean difference of SBP after 8 hours of work was statistically significant between the controls and dayshift (p= 0.002) and also between controls and nightshift workers (p= 0.000). The mean difference between the dayshift workers and night shift workers was statistically insignificant (p= 0.501).

Table 4: Comparison of Diastolic Blood Pressure before start of work between the study groups

Groups	**DBP Before start of work Mean ± SD**	**F Value**	**'p' Value**
Controls (n=30)	78.600 ± 5.256	0.631	0.743
Dayshift (n=30)	80.067 ± 4.378		
Nightshift (n=30)	81.600 ± 2.749		

SD – Standard Deviation, * p <0.05 was considered as statistically significant

The mean DBP before start of work between the groups is statistically insignificant as shown in table 4. In multiple comparisons, the mean difference between controls and nightshift workers (p= 0.021) is statistically significant but the mean difference between the controls and dayshift workers (p= 0.380), dayshift and nightshift workers (p= 0.348) are insignificant.

Table 5: Comparison of Diastolic Blood Pressure after 8 Hours work between the groups

Groups	DBP After 8 hours work Mean ± SD	F Value	'p' Value
Controls (n=30)	81.733 ± 5.323	0.465	0.867
Dayshift (n=30)	85.133 ± 3.471		
Nightshift (n=30)	85.067 ± 3.268		

SD – Standard Deviation, * p <0.05 was considered as statistically significant

The mean DBP after 8hours of work is statistically insignificant as seen in table 5. In multiple comparisons mean difference in the DBP between controls, dayshift (p= 0.006) and nightshift workers (p= 0.007) were significant. The mean difference between the dayshift and nightshift workers was insignificant (p= 0.998).
The correlation of years of exposure to noise with blood pressure in Dayshift workers and night shift workers were depicted in table 6 and 7 respectively.

Table 6: Correlation of years of exposure with blood pressure in Dayshift Workers

Variables		r Value	'p' Value
Before start of work	SBP	0.3845	0.0359*
	DBP	0.1488	0.4325
After 8 hours work	SBP	0.3546	0.0545
	DBP	0.2451	0.1917

*** p <0.05 was considered as statistically significant**

Table 7: Correlation of Years of Exposure with blood pressure in Nightshift Workers

Variables		'r' Value	'p' Value
Before start of work	SBP	0.6144	0.0003*
	DBP	0.3293	0.0756
After 8 hours work	SBP	0.6017	0.0004*
	DBP	0.2678	0.1525

*** p <0.05 was considered as statistically significant**

DISCUSSION

The present study was conducted among 60 textile mill workers in age group of 20 to 50 years to find out whether noise affects blood pressure of the individual. The workers were exposed to noise levels of 74 dB(A) to 97 dB(A) [Permissible limit – 90 dB (A)]. To implement this, we had chosen 60 textile mill workers (30 workers working in Day Shift and 30 workers working in Night shift) and 30 controls.
In this study it was found that there was significant difference in the mean SBP and DBP between the workers and the controls. Also, it was found that there existed a significant difference in SBP and DBP before start of work and after 8 hours of work.
However, in intergroup comparison between the controls, dayshift and nightshift workers, the SBP showed significant increase in the study group while DBP between the controls, dayshift and nightshift workers was insignificant. On correlating the years of exposure with the blood pressure it was found that SBP in Dayshift workers before start of work correlated positively which was significant and, SBP in Night shift workers before start of work and after 8 hours of work correlated positively which was significant. Other correlation findings were insignificant.

In a laboratory study in borderline hypertensive rats, Fisher and Tucker observed that exposure to air jet noise led to elevated SBP and DBP. SBP was elevated significantly even at 1 week of exposure. Ten weeks of noise stress showed significant increase in SBP, DBP and mean arterial pressure. They suggested that it was the structural changes rather than the autonomic effects which might have influenced the elevation of blood pressure especially mean arterial pressure and DBP. The results were consistent with our study.[11] Sangeeta Singhal et al observed significant increase in SBP and DBP in workers exposed to noise levels above 80 dB(A). They attributed these results to the catecholamines released from the adrenal medulla due to activation of adrenergic system, release of steroids from adrenal cortex and also direct noise effects on arterial wall tension. Sympathetic nervous system stimulation by noise leads to increase in myocardial contractility and total peripheral resistance. Chronic noise stimulation accelerates the structural changes in peripheral resistance vessels causing permanent blood pressure elevation. The results of this study were supportive to our study.[12]

In a study by Ahmed Emara et al, workers were exposed to impact noise and continuous noise in industries of about 75-130 dB and it was observed that both SBP and DBP were elevated in the workers exposed to continuous noise. He pointed out that this might be due to increased sympathetic activity arising due to increased stress caused by noise. This brings a point that type of noise exposure also influences the cardiovascular parameters. The results were consistent with our study.[13]

Tomei F and co-workers in their study showed that workers with poor hearing who were exposed to high frequency continuous noise, had higher SBP and DBP than those with normal hearing. This study showed that type of exposure and noise intensity influences the cardiovascular effects.[14]

Bachtiar Chahyadhi et al said that the noise that exceeds the safe threshold level becomes a risk factor for increasing systolic and diastolic blood pressure. So if it is not addressed then it may become an important health concern in the future. [15] He further suggested to use three modalities viz. engineering methods, administrative methods, and the use of personal protective equipment to reduce the impact of noise.

Shift working and noise exposure have additive effect in increasing SBP and DBP by activation of sympathetic nervous system, reduced arterial compliance and sympatheticotonia induced lesion of the endothelial walls. The mean SBP and DBP were significantly higher in shift workers than the daytime workers which is consistent with our study. This may be due to other life style related factors like disruption of circadian rhythm, stress and behavior modifications in shift workers.[16]

In female textile mill workers, Ni Chun-hui et al observed an association between loud noise exposure and decreased arterial compliance which will lead to increase in SBP and DBP.[17]

Transient and sustained noise effects studied by 24-hour ambulatory blood pressure measurement in automobile workers showed increased SBP even at low levels of noise and the sustained noise effect was evidenced by increase in sleep time SBP. The possible causes may be stress induced hormonal release especially cortisol on chronic noise exposure and sympatheticotonia induced endothelial lesion activating the sympathetic reflex leading to structural changes and sustained elevation of blood pressure.[18]

Powazka in his study on noise exposure in workers observed that noise exposure and physical exertion led to an increase in SBP, but no effect was seen on DBP.[19] Lee et al in their study on metal factory workers observed that chronic noise exposure leads to increased SBP which was proportional to noise intensity. There was no effect on DBP. The results were consistent with the present study.[20]

Positive correlation between years of exposure to noise and elevated blood pressure has been observed in several studies in industrial workers.[20-22] Negative correlation between years of exposure to noise and blood pressure was observed in steel workers by Powazka.[19]

In the present study SBP was correlated positively with years of exposure. This might be due to increased sympathetic reflex activity to noise which increases the myocardial contractility and also accelerate the vasomotor changes occurring in the cardiovascular system.[18]

In intraday analysis of blood pressure variation, significant difference was observed in both SBP and DBP between controls and workers as depicted in table 1. The results were consistent with studies conducted in workers who were exposed to noise levels above 80 dB(A). This may be due to acute noise exposure activating the sympathetic reflex action immediately.[18][23]

The probable mechanisms for elevated blood pressure may be that noise acts as stressor. This auditory stimulation activates the higher cortical centers through reticular activating system and stimulates sympathetic nervous system and endocrine glands. Autonomic nervous stimulation causes vasoconstriction, increases myocardial contractility and total peripheral resistance. Adrenal medulla and cortex release adrenaline, noradrenaline and cortisol respectively as a reaction to stress to maintain homeostasis. Direct effect of noise causes vasomotor changes in peripheral resistance vessels leading to permanent rise of blood pressure. Noise effect may be direct or indirect which alters metabolic equilibrium, enhances biological risk factors and stressors leading to elevated blood pressure.

Wearing hearing protection devices by industrial workers protect them from occupational noise and significantly reduce their effects on blood pressure.[24-25] Thus, routine health check-up in industrial workers is mandatory for the overall well-being of the workers. In this study, we had included textile mill workers and made an attempt to find the increased blood pressure in the workers.

CONCLUSION

In our study, results strongly suggest that there is a difference in systolic and diastolic blood pressure between textile mill workers and controls, before start of work and after 8 hours of work which was proved significant. Also, systolic blood pressure was significantly increased in dayshift and night shift workers compared to controls. On correlating years of exposure with blood pressure, systolic blood pressure before start of work correlated positively in day shift workers and, systolic blood pressure before start of work and after 8 hours of work correlated positively in night shift workers.

Henceforth, the results obtained with the present study allowed us to primarily conclude that the industrial workers should be screened for cardiovascular dysfunctions and early intervention should be done by preventive and definitive measures, improving both their physical and mental health which might pave the way for increased productivity from a healthy worker.

Limitations

The sample size of the present study was small. Noise is not the only stress factor in the industry but the workers are exposed to both physical factors like vibration, illumination, ventilation, air pollution, heat and mental factors like workload, performance pressure, time constraints which along with external factors have a major impact on the health of the workers. These multiple factors influencing stress and blood pressure cannot be represented by studying a single factor, noise. Hence a wider study involving multiple factors may be an appropriate one to study the occupational health of the workers.

Future scope of the study:

- Occupational health of the workers can be studied in the context of multiple factors they are exposed.
- The study can be further extended by involving a larger sample size.
- Noise induced effects on the workers can be further studied with or without personal hearing protection devices to study their beneficial effects.

Declaration by Authors

Ethical Approval: Approved

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