THE LONG-TERM IMPACT OF EXPOSURE TO AIRBORNE POLLUTANTS: A COMPARATIVE STUDY OF RESPIRATORY SYMPTOMS, DISORDERS, AND LUNG FUNCTION IN ELDERLY RETIRED POWER LOOM MILL WORKERS

Principal Authors:
Keerthika.S[1], Kowsalya.M[2],

[1]*Department of Pharmacy Practice, JKKN College of Pharmacy, Kumarapalayam-638183, Tamil Nadu, India. Email id: keerthikask125@gmail.com , Mobile no: 6374020470*
[2]*Department of Pharmacy Practice, JKKN College of Pharmacy, Kumarapalayam-638183, Tamil Nadu, India. Email id: kowsalyamaniammu197@gmail.com , Mobile no: 8248558355*

Corresponding Author:
[1]*N.Venkateswaramurthy, Head of the Department, Department of Pharmacy Practice, JKKN College of Pharmacy, Kumarapalayam-638183, Tamil Nadu, India. Email id: nvmurthi@gmail.com , Mobile no: 98427 24689*

KEYWORDS
Airborne pollutants, Power loom mill workers, non-workers, Respiratory symptoms, disorders, PEFR.

ABSTRACT

Background: Cotton industry workers face multiple hazards, leading to health issues like respiratory problems, byssinosis, bronchitis, and asthma. Occupational exposure in the textile industry, like cotton processing, can cause lung diseases, including Byssinosis, and increase the risk of respiratory complications, reduced lung function, COPD.

Objectives: To assess the respiratory health and lung function in retired power loom mill workers and compare it with non-workers of a comparable age group. The primary objective was to assess and compare the respiratory symptoms and lung function between these two groups.

Methodology: This study conducted in Kumarapalayam, known for its power looms, focused on assessing the respiratory health of elderly individuals, specifically retired power loom mill workers (n=102), and those who never worked in such mills (n=67), all aged 60 years and above. Non-power loom mill workers served as the control group. Lung function was assessed using a mini wright peak flow meter to measure peak expiratory flow rates. Rigorous statistical analysis was applied to detect significant differences or patterns between the two groups.

Result and Discussion: In our study of elderly male power loom mill workers, age was associated with declining PEFR values compared to non-workers. Among 63 elderly male and 39 elderly female mill workers, indicated a negative relationship between the length of employment and PEFR values. Interestingly, both genders exhibited improved respiratory function after retirement. Smoking exacerbated PEFR decline in elderly male workers, who also experienced a higher prevalence of respiratory issues. This underscores the occupational hazards they faced.

Conclusion: Elderly power loom mill workers exhibit a marked decline in respiratory function due to occupational exposure, with smoking exacerbating this decline. However, post-retirement shows a gradual improvement in respiratory health, emphasizing the lasting impact of the work environment.

Key Message:
Occupational exposure in power loom mills significantly impacts long-term respiratory health, particularly in elderly workers, with smoking further exacerbating these effects. Post-retirement improvement highlights the need for protective measures during working years.

INTRODUCTION:

Occupational respiratory diseases a major significant global public health challenge, comprising around 30% of all recorded work-related illnesses. Additionally, respiratory problems contribute to 10–20% of fatalities associated with occupational health issues.[1] Due to exposure to airborne particulates in the workplace, approximately 386,000 deaths and nearly 6.6 million disability-adjusted life years (DALYs) were recorded among workers.[2] In India, approximately 20 million workers are employed in the textile industry. Long-term exposure to cotton, flax, hemp, or jute fibers/dust can lead to permanent lung and airway scarring, causing debilitating lung diseases.[3]
Many studies[4,5] have been reported on the lung function of cotton mill workers under 60 years old, but None of the study conducted on the elderly population who have worked in power loom mills for prolonged periods. It's known that lung function tends to decrease with age in the elderly. prolonged exposure to cotton dust may exacerbate respiratory function decline. Therefore, compare the analysis of lung function between power loom mill workers and non-mill workers.

MATERIALS AND METHODS:

Study Population:

Ethical clearance for the present study was taken from the Institutional Ethics Committee. This comparative cross-sectional study was conducted in nearby rural areas in Kumarapalayam taluk. The sample size was determined using RaoSoft with a 5% margin of error and 95% confidence interval, and the estimated sample size was 169 participants. Retired Participants' details were collected near the power loom association. Elderly Retired power loom mill workers were identified based on inclusion criteria, specifically those who had worked for a minimum of 10 years, randomly selected from a provided list. For the non-mill worker comparison group, participants were required to have similar, ages and reside in areas where the power loom mill is not located.

Questionnaire:

The initial interview phase involved administering a concise questionnaire. Participants provided personal details such as name, age, and smoking history. Respiratory symptoms like coughing, wheezing, and shortness of breath were documented. Work history inquiries covered occupation, mill worker employment details, post-retirement periods, working hours, ventilation, and protective equipment usage. Additionally, participants reported any diagnosed respiratory conditions. Lung function was assessed using a peak flow meter. The questionnaire aimed to efficiently collect essential information on participants' backgrounds, respiratory health, and occupational exposures without grammatical errors for subsequent analysis.

LUNG FUNCTION TEST ON PEFR:

The Lung volume was measured using a Mini Wright peak flow meter (Cipla Ltd., India). At least three readings were taken from each participant, and the highest value was recorded for data analysis. All readings were expressed in liters per minute. Predicted values were calculated based on age and height using the formula: -663.4 - 3.37 (age in years) + 7.86 (height in cm) ± 84, as described by Dikshit and Jog.[6]
All participants were approached, informed about the study's purpose and procedures, and their informed consent was obtained through signed consent forms. Data collection was conducted through face-to-face interviews, followed by comparative analysis to interpret and draw meaningful

conclusions from the findings.

Statistical Analysis:

The evaluation of respiratory symptoms, disorders and lung function test was done in all subjects. The collected data were entered into an Excel sheet and analyzed using SPSS Vs 27. The spirometry data and baseline characteristics of the subjects were compared using Mann- whitney U tests, T-tests, Multiple linear regression models, chi-square tests. The data were considered statistically significant with a p-value <0.05.

RESULTS:

All 102 exposed (power loom mill workers) and 67 (non-workers) unexposed groups underwent an interview such as demographic details, respiratory symptoms and disorders, and assessment of PFTs using elderly retired power loom mill workers and non-workers.

Figure 1: Analyzing the Correlation Between Duration of Employment in Power Loom Mill workers and Observed PEFR Values Among Both Male and Female Workers

Our study on elderly retired male (63) and female (39) mill workers found a negative correlation between the duration of employment in power loom mill workers and observed PEFR value, with males experiencing a steeper decline (5.85 l/min) compared to females (4.49 l/min).

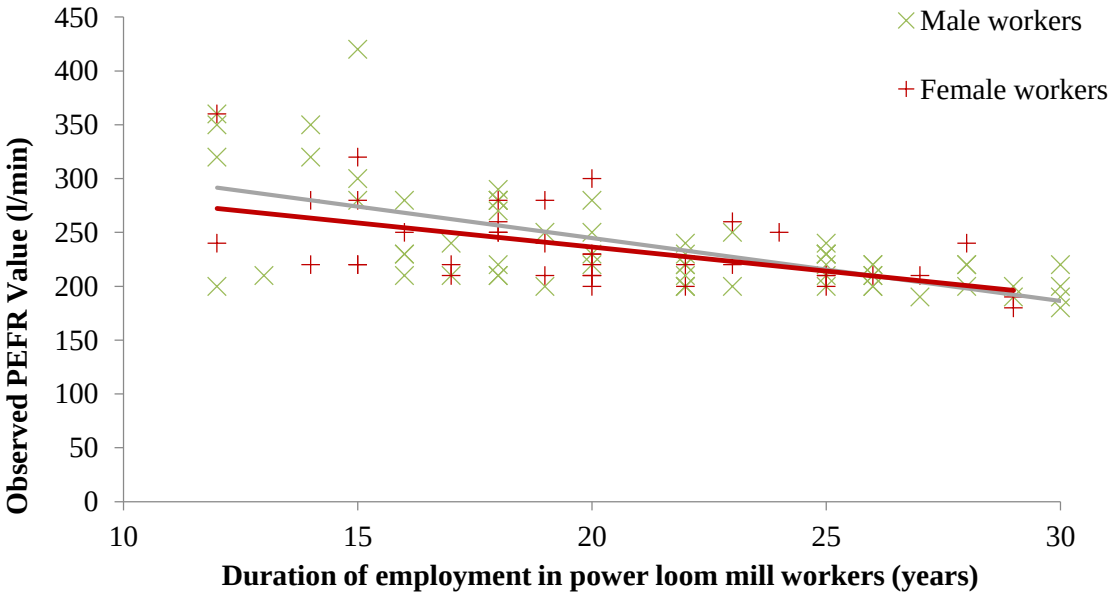

Figure 2: Analyzing the Correlation Between Years Post-Retirement and Difference between Observed value versus predicted value of Peak Expiratory Flow Rates in Both Male and Female Retired workers

Our study shows a positive correlation between years since retirement and improved PEFR in male (0.535) and female (0.685) mill workers, with greater improvement in females.

Table 1: Analyzing PEFR: Comparing Mean ± SD of Observed and Predicted Values in Male Power Loom Mill Workers and Non-Workers by Age Group

S.No	Age group (Years)	Power loom mill worker –Male (N=63)	Non mill worker – Male (N=27)
		Observed PEFR value (l/min) (Mean ± SD)	Observed PEFR value (l/min) (Mean ± SD)
1.	60-65	227±39	278±46
2.	66-70	239±47	306±85
3.	71-75	283±91	345±76
4.	>76	303±40	365±21
P Value < 0.05- statistically significant			

Table 1- In our study, we analyzed Peak Expiratory Flow Rate (PEFR) and compared the mean ± SD of observed values between male Power Loom Mill Workers and Non-Workers across different age groups. The study revealed a significant difference (P Value < 0.05) among various age groups in elderly retired male power loom mill workers and non-workers in the 60-65 and 66-70 age groups.

PEFR values were compared in female power loom mill workers and non-workers across age groups. No significant differences were found in the 60-70 age range, but no female mill workers were present in the older age groups.

Table 2: Analyzing the Impact of Smoking Status on Observed and Predicted PEFR Values Among Power Loom Mill Workers & Non mill workers

S.No	Smoking status	Power loom mill workers (N=63)	Non mill workers (N=29)
		Observed PEFR value (l/min) (Mean ± SD)	Observed PEFR value (l/min) (Mean ± SD)
1.	Smoker	231±40	284±64
2.	Non-smoker	274±67	366±63
P Value - <0.05 – Statistically significant			

Table 2- In our study, smokers had significantly lower observed PEFR values compared to non-smokers. A negative t-statistic suggests smokers among mill workers have lower mean PEFR than non-mill worker smokers. The p-value of 0.00161 is statistically significant ($p < 0.05$).

Table 3: A Comparative Analysis of the Prevalence of Respiratory Symptoms in Male power loom mill workers and non-mill workers & Female Mill Workers and Non-Workers

S.No	Symptoms	Male Power loom mill workers (n=63)	Male Non mill workers (n=29)	Female Power loom mill workers (n=39)	Female non mill workers (n=38)
1.	Coughing	54 (86%)	22 (76%)	29 (74%)	22 (58%)
2.	Shortness of breathing	40 (63%)	15 (52%)	28 (72%)	14 (37%)
3.	Wheezing	13 (21%)	3 (10%)	9 (23%)	7 (18%)
4.	Chest tightness	30 (48%)	8 (28%)	13 (33%)	9 (24%)
5.	Difficulty breathing	39 (62%)	11 (38%)	22 (56%)	3 37%)

Table 3- In our study, we conducted a comparative analysis of respiratory symptom prevalence among elderly retired male power loom mill workers (n=63), a higher prevalence of respiratory symptoms, including coughing (86%), shortness of breath (63%), and difficulty breathing (62%), was observed compared to male non-workers (n=29). In our study, we conducted a comparative analysis of respiratory symptom prevalence among female power loom mill workers (n=39) and non-workers (n=38). Elderly retired Female power loom mill workers exhibited a higher prevalence of coughing (74%) and shortness of breath (72%) compared to female non-workers (coughing: 58%, shortness of breath: 37%).

Our study reveals a significantly higher prevalence of respiratory diseases, specifically asthma (78%) and COPD (88%), among power loom mill workers compared to non-workers (asthma: 22%, COPD: 12%).

DISCUSSION:

Our study evaluated the prevalence of respiratory symptoms and lung function among elderly retired power loom mill workers compared to a control group of non-workers. We analyzed a sample of 102 former mill workers and 67 non-workers, considering demographic variables such as age and gender distribution.

Peak Expiratory Flow Rate (PEFR): Our study revealed significant differences in PEFR values among male power loom mill workers and non-workers in the 60-65 and 66-70 age groups, with workers exhibiting significantly lower PEFR values ($P < 0.05$). This finding aligns with Dikshit M.B.[6] research, which demonstrated a decline in PEFR with increasing age. For female workers, no significant differences in PEFR values were found between mill workers and non-workers in the 60-70 age range. Female mill workers were notably absent in older age groups. Sandhu et al.[7] found a negative correlation between age and PEFR in urban and rural females, with the lowest PEFR in the 85-94 age group. Farooque et al.[8] emphasized the health risks associated with long-term exposure to fibers/dust, leading to diseases like byssinosis.

Employment Duration: For elderly retired male (n=63) and female (n=39) mill workers, we found a negative correlation between employment duration and PEFR values. Males experienced a steeper decline in PEFR (5.85 l/min) compared to females (4.49 l/min). Tiwari et al. noted a decrease in PEFR values with increasing exposure, particularly in those with over 30 years of exposure, indicating an elevated risk of obstructive disease. Suryakar et al.[9] showed that cotton dust exposure induces oxidative stress, worsening with longer exposure durations.

Correlation and Regression Analysis: The study revealed that males exhibit a stronger association between work duration and lung function decline (correlation coefficient 0.64) compared to females (0.55). Regression coefficients indicated steeper declines in PEFR per year of work for males (5.85 l/min) and females (4.49 l/min). R-squared values (0.41 for males and 0.29 for females) highlight the proportion of predictable variance in lung function decline due to work duration, underscoring the significant impact of long-term occupational exposure.

Post-Retirement Improvement: There was a positive correlation between years since retirement and potential improvement in lung function among retired workers, with correlation coefficients of 0.535 for males and 0.685 for females. Regression coefficients indicated an increase in PEFR with each additional year post-retirement (5.8127 for males, 11.4907 for females). R-squared values (0.286 for males and 0.469 for females) underscore the proportion of predictable variance in lung function attributed to post-employment factors, emphasizing their importance in respiratory health management for retired industrial workers.

In our study, smokers exhibited lower PEFR values, indicating declining lung function in retired male power loom mill workers. This highlight compounded respiratory risks from smoking and occupational exposure. Similarly, Tiwari et al.[10] (2010) observed reduced PEFR values in smokers among adult hand loom weavers, likely due to enlarged mucosal cells from cotton dust and smoke irritation, aligning with our findings. Both studies underscore smoking and occupational exposure's detrimental impact on respiratory health.

Our study (n=63) revealed higher rates of coughing (86%), shortness of breath (63%), and difficulty breathing (62%) among retired male power loom mill workers compared to non-workers (n=29), indicating occupational exposure's significance. Similarly, Dangi et al.[11] noted increased respiratory symptoms in adult cotton mill workers, emphasizing workplace exposure's impact. In our study (n=39 female mill workers, n=38 non-workers), retired female power loom mill workers exhibited elevated coughing (74%) and shortness of breath (72%) rates versus non-workers (coughing: 58%, shortness of breath: 37%), suggesting occupational influence. Daba Wami et al.[12]

also found significant prevalence of cotton dust-induced respiratory symptoms among exposed workers, reaffirming elevated respiratory symptom prevalence due to occupational exposure in elderly male and female power loom mill workers.

In our study, respiratory diseases, notably asthma (78%) and COPD (88%), were significantly more prevalent among power loom mill workers compared to non-workers (asthma: 22%, COPD: 12%), highlighting the heightened risk associated with occupational exposure. Similarly, Lai et al.[13] found that exposure to organic dust in the textile industry leads to obstructive lung disease with features of both asthma and COPD, suggesting the importance of stopping workplace exposure to improve lung function and understand the condition better.

CONCLUSION:

This study to report, the lasting impact of air pollution on the respiratory health of retired power loom mill workers, even after they stop working. It highlights higher risks of breathing problems and reduced lung function among retirees, with smoking playing a significant role. The findings stress the importance of proactive measures to safeguard the health of both current and retired workers in the industry. Moreover, the study emphasizes the need for gender-specific policies to address respiratory issues and advocates for promoting workplace safety standards to protect the well-being of all power loom workers, now and in the future.

LIMITATION:

- The study was conducted in a specific rural area, which may not be representative of all power loom mill worker populations, potentially limiting the generalizability of the results.
- The study's sample size may be small, which could impact how well the findings apply to everyone. A bigger sample would give stronger results.
- The study does not account for external factors that may influence respiratory health outcomes such as environmental conditions, access to healthcare, and lifestyle habits.
- The study had limitations, including the absence of additional lung function tests besides spirometry.

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