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Original Research Article

Pulmonary Morbidity of Workers and Local Residents of a Spinning Mill in Kerala: A Comparative Study

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Abstract:

Background: Appropriate legislative and protective measures are in place for safeguarding spinning mill workers from health risks. But there is lack of strict monitoring of air pollutant emission from spinning mills and pulmonary morbidity of residents nearby has not been explored adequately yet. Hence this study was undertaken with the objective of comparing pulmonary morbidity of workers and local residents of a spinning mill in central Kerala.

Methods: Community based cross-sectional analytical study was done in spinning section of an NTC mill and residential areas within one-kilometre radius, during 2013-2015. 91 workers along with an equal number of age and sex matched residents were selected. Data collected included history, clinical examination and pulmonary function tests. Descriptive statistics, chi-square test, independent t test and Mann-Whitney U test using SPSS statistical software - version 16 were used for statistical analysis.

Results: 64.8% residents yielded an abnormal pulmonary function compared to 27.5% of workers ($p<0.0001$; OR:4.87; CI=2.6-9.1). Residents showed a statistically significant association between duration of stay near mill and PFT($p<0.05$). Of those with >20 years of exposure,78.3% of residents were found to have an abnormal PFT compared to 38.9% of workers ($p<0.0001$; OR:5.68; CI=2.3-14.1). Odd's ratio (OR) for residents developing an abnormal PFT was found to be 4.87(CI=2.59-9.14) compared to workers.

Conclusion: Pulmonary morbidity among local residents was higher compared to workers. This emphasizes the need to create awareness among local residents of spinning mills and implement interventions to safeguard them from pulmonary morbidity in addition to routine protective measures taken for workers inside spinning mill.

Keywords: Local Residents; Pulmonary Morbidity; Spinning Mill Worker.

Introduction

Textile dust exposure reduces lung function, increases airway reactivity leading to various respiratory illnesses [1,2,3]. Government of India has recommended specific protective and preventive measures for textile mill workers [1,4]. Residents near a textile mill are also exposed to textile dust but no protective recommendations for them are in place. Very few studies have been conducted on pulmonary morbidity of spinning mill workers in Kerala and residents near a spinning mill is often overlooked. Hence present study was undertaken with the aim of comparing acute and chronic pulmonary morbidity among spinning mill workers and local residents in central Kerala.

Material and Methods

After obtaining necessary clearances, a community based cross-sectional analytical study was undertaken from October 2013-September 2015 among workers, in spinning section of an NTC mill in central Kerala, and age and sex matched individuals living within one km radius (for a minimum duration of one year), who were not spinning mill workers. Workers having any known pulmonary/cardiac diseases, on treatment (inhaled bronchodilator or steroids) during enrollment, residents on inhaled bronchodilator/steroids prior to residing in study area, people working earlier in spinning mills and now residing in study area, pregnant women, and those unable to do pulmonary function tests using spirometer were excluded. A sample size of 166 was calculated as for a cross-sectional analytical study, taking prevalence of respiratory problems among textile workers [5] and prevalence of respiratory symptoms in urban Kerala [6] as references, at an allowable error of 20% at 95% confidence level assuming a non-response rate of 15%. Total sample size taken was 182. 91 out of 110 workers in spinning section who met inclusion criteria were selected. Age and sex

matched local residents identified with the help of Accredited Social Health Activists (ASHAs) and first 91 residents listed were selected. Socio-demographic factors, smoking and cooking practices, medical history, anthropometry, general examination and pulmonary function tests (PFT) were studied. All were interviewed using proforma adapted from ICMR-INSEARCH study, based on International Union Against Tuberculosis and Lung Diseases (IUATLD) bronchial symptom questionnaire.[6] PFT including peak expiratory flow rate measured with the help of a trained technician and standardized as per standard practice established.[7] Whenever needed, opinion of a Pulmonologist was taken. Data collected was coded and analyzed using Statistical software Statistical Package for Social Sciences (SPSS Version-16). Predicted values of FEV1, FVC, FEF 25-75% and PEFR for each study subject calculated using standard prediction formulae [7] and percentage predicted value of each parameter determined.

Appropriate statistical analysis methods like Chi-square test, independent t-test and Mann-Whitney U test were used. Informed written permission was obtained from spinning mill authority and respective Municipal Corporation Mayor. Informed written consent was taken from study participants. Ethical conduct and strict confidentiality of information was maintained throughout.

Results

Table 1: Atopy

Atopic Symptoms	Workers n=91 (100%)	Residents n=91 (100%)	Statistical test value*, p value†
Itching on skin			0.000*, 1.000
Yes	15 (16.48)	15 (16.48)	
No	76 (83.52)	76 (83.52)	
Watering from eyes			8.273*,0.004
Yes	7 (7.69)	21 (23.08)	
No	84 (92.31)	70 (76.92)	
Redness in eyes			6.642*,0.010
Yes	15 (16.48)	30 (32.97)	
No	76 (83.52)	61 (67.03)	
Frequent Sneezing			2.758*,0.097
Yes	20 (21.98)	30 (32.97)	
No	71 (78.02)	61 (67.03)	
Rhinitis			2.795*,0.095
Yes	2 (2.20)	0 (0)	
No	89 (97.80)	91 (100)	
Family History			10.581*,0.001
Yes	10 (9.1)	0 (0)	
No	81 (90.9)	91 (100)	

*Chi square test

†p value <0.05 significant

Table 2: PFT Findings

PFT Findings (Mean ± SD)	Workers n=91	Residents n=91	T value	p Value†
FEV_1 (L): Observed	2.07±0.48	1.85±0.63	2.594	0.010
Predicted	2.12±0.39	2.15±0.53	0.497	0.620
FEV_1 %Predicted	98.15±16.7	85.62±19	4.721	<0.0001
FVC (L) : Observed	2.37±0.57	2.09±0.70	2.946	0.004
Predicted	2.72±0.59	2.76±0.70	0.395	0.694
FVC %Predicted	87.84±15.43	75.65±17.35	5.007	<0.0001
FEV_1/FVC: Observed	0.88±.11	0.90±0.17	0.817	0.415
Predicted	0.78±0.04	0.78±0.03	0.369	0.713
FEV_1/FVC %Predicted	112.7±13.9	115.2±21.5	0.917	0.956
$FEF_{25-75\%}$: Observed	2.83±0.82	3.13±1.30	1.891	0.061
Predicted	3.35±0.34	3.37±0.81	0.214	0.831
$FEF_{25-75\%}$ %Predicted	83.97±21.5	91.52±30.3	1.940	0.054
PEFR(L/min): Observed	387.47±113.4	386.37±130.7	0.061	0.952
Predicted	423.59±75.1	429.82±90.7	0.505	0.614
PEFR %Predicted	90.83±17.6	99.95±18.9	0.694	0.489

†p value<0.05 significant

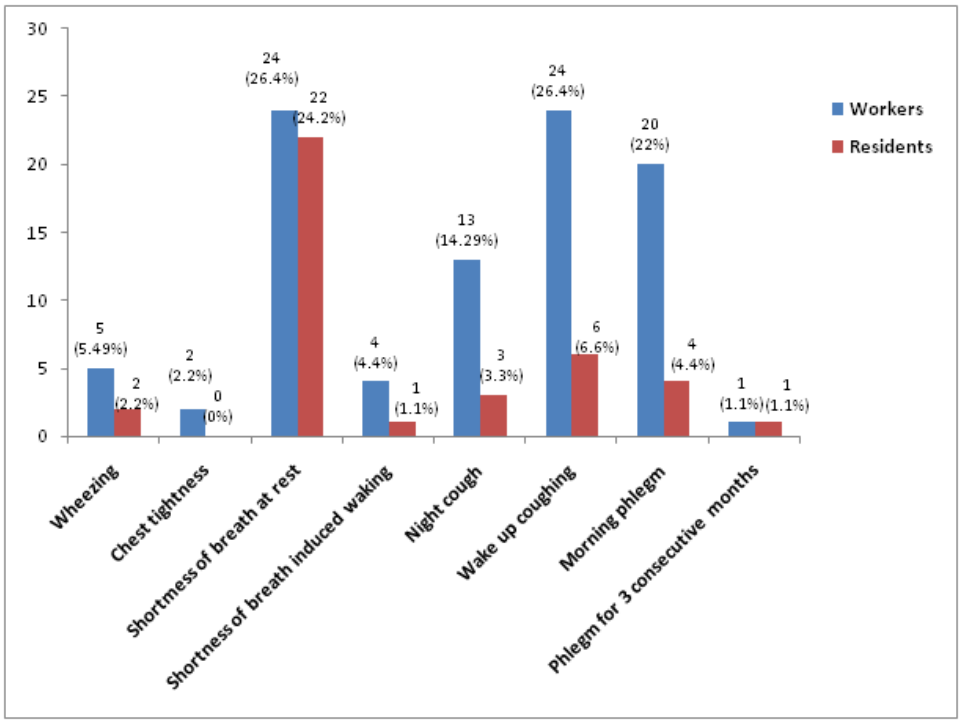

Figure 1: Respiratory Symptoms

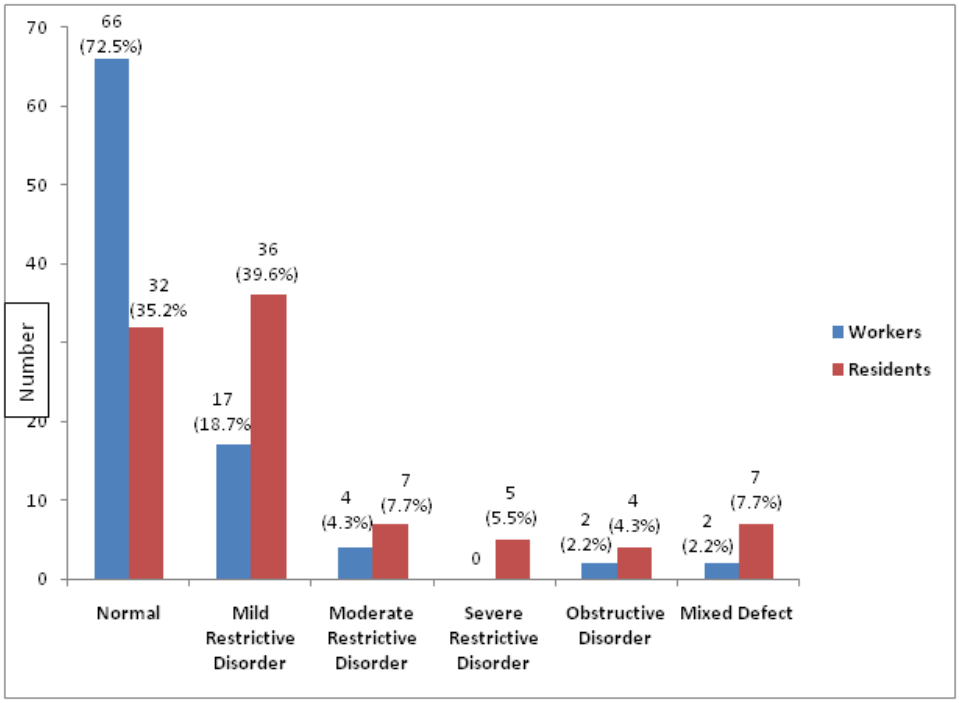

Figure 2: PFT Classification

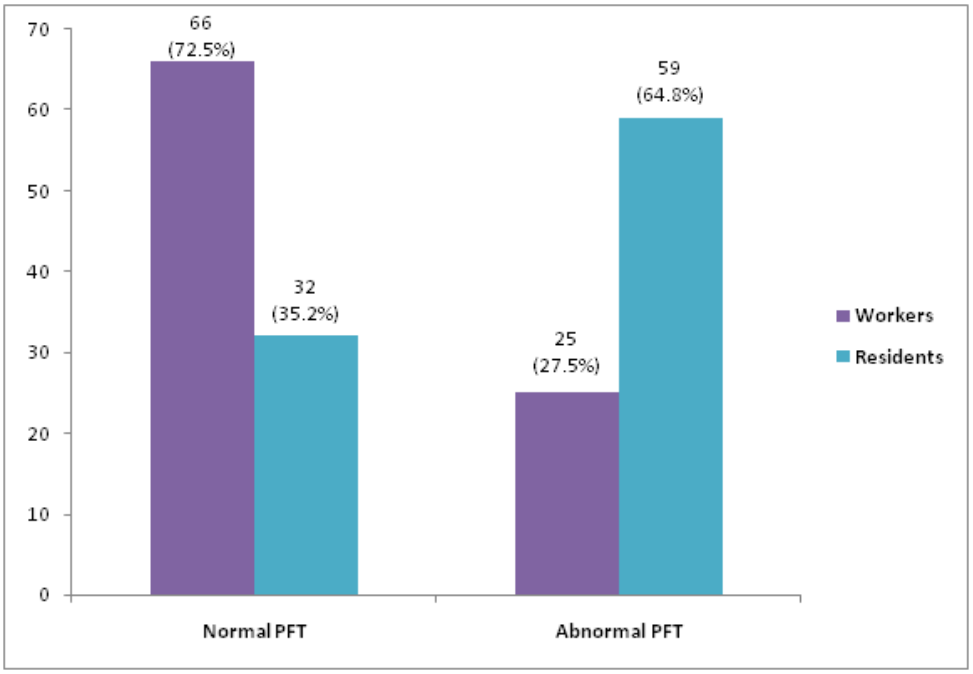

Figure 3: Comparison of PFT

Workers and residents were comparable in terms of age, gender, marital status and educational status. There was statistically significant difference between both groups in terms of religion, occupation, family income per month and socio-economic status($p<0.05$). Difference in occupation was because 98.9% workers came under skilled category of occupation while residents were spread uniformly over all occupational categories.

Workers and residents were comparable in terms of ever smoking and current smoking status, with only 13.19% workers and 14.28% residents being current smokers($p=0.598$). Smokers in both groups did not show any statistically significant difference in duration($p=0.250$) or median quantity of smoking/24 hours($p=0.825$). All women studied were non-smokers. No significant association was found between smoking status and PFT in both groups (p value=0.935; OR=1; 95% CI=0.54-1.96). Statistically significant difference was found only in type of tobacco used among smokers($p=0.01$) and passive smoking among non-smokers ($p=0.001$)

No statistically significant difference was noted among both groups in terms of cooking practices($p=0.300$), mean hours spent in kitchen($p=0.286$), predominantly used cooking fuel($p=0.538$), kitchen ventilation.

No statistically significant difference was noted among workers and residents in terms of co-morbidities like diabetes mellitus, hypertension, chronic heart disease, cerebrovascular accidents, old tuberculosis, type of old tuberculosis.

Atopic symptoms were more among residents (Table 1) while respiratory symptoms were slightly more among workers (Figure 1), Statistically significant difference was seen in symptoms of night cough($p=0.009$), night cough induced waking($p<0.0001$), morning phlegm production($p<0.0001$).

Workers and residents were comparable in terms of height, weight, BMI of females, mean pulse rate of females, mean SBP and DBP of males. Mean weight($p=0.034$) and mean BMI($p=0.001$) of male residents were more than that of male workers. Mean pulse rate of male workers was higher than that of male residents($p<0.0001$). There was statistically significant difference among female workers and residents in mean SBP($p=0.001$) and mean DBP($p=0.008$). On examination, skin and eye abnormalities were more pronounced among residents while nose, throat and lower respiratory abnormalities were more common among workers.

Pulmonary morbidity was more pronounced among residents, with 64.84% of residents having an abnormal PFT compared to 27.47% of workers ($p<0.0001$)(Table2, Figures2 and 3). Odd's ratio (OR) for residents developing an abnormal PFT was found to be 4.87(CI=2.59-9.14). Residents showed statistically significant difference in duration of stay near mill and lung function($p=0.038$) and derangement in lung functions was higher in those with >20 years of exposure($p=0.002$).

Discussion

All respiratory symptoms were higher among workers compared to residents in our study, similar to studies done in Nigeria[9], China [10,11], Uttar Pradesh [12] and Finland [13]. Nigerian study [9] showed more prevalence of atopic symptoms in

exposed workers compared to unexposed group unlike our study.

Mean FEV1 and mean FVC among workers was comparable to studies done in Andhra Pradesh [14] and in Uttar Pradesh [15] while it was slightly lower in a study done in Hubli [16]. Mean FEV1 and mean FVC among control groups studied in Andhra Pradesh [14], Uttar Pradesh [15] and Hubli [16] was higher than that of residents in this study. FEV1/FVC ratio obtained was comparable to that seen in Hubli [16] study. Observed FEF25-75% and PEFR were comparable to that in Andhra Pradesh study [14].

Conclusion & Recommendations

Residents had more pulmonary morbidity compared to workers. This lower risk of pulmonary morbidity among workers may be attributed to inherent protective mechanisms inside mill to reduce cotton dust concentrations, use of protective equipments like masks, gloves by workers. There might also be a chance for heavier dust particles to settle down within mill premises and smaller dust particles to disseminate more into surrounding areas by way of natural environmental forces like wind. Median duration of exposure is greater among residents than for workers and this might also be a reason for greater dysfunction among residents. Residents neither use any protective equipment nor take any measures to reduce their exposure to cotton dust in their immediate environment, thus making them more susceptible to pulmonary morbidity, as is evident from this study.

Interventions to reduce dust dissemination from inside mill to immediate surroundings, probably by using wetting procedures inside mill compound to decrease aerosols, in addition to already prevalent protective measures like local exhaust ventilation with attached dust collection bag, dilution ventilation, good housekeeping practices need to be undertaken. Periodic ambient air dust concentration monitoring of mill and local environment every 6 months, regular health checkups and follow up for both groups with yearly pulmonary function tests/X-rays need to be thought of. Concerned mill and government authorities need to work hand-in-hand in creating awareness among people and resolving pulmonary morbidity and strive towards improving people's health.

Limitations

Environmental cotton dust concentrations were not analyzed. Sputum evaluation and follow up was not done. Healthy worker effect may have influenced results among workers.

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Conflict of interest: None

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