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Assessment of Respiratory Health among Selected Leather Manufacturing Workers of Urban Puducherry

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ABSTRACT

Globally, industrial workers are exposed to various chemicals and particulate pollutions frequently, which act as causative agent for chronic respiratory diseases. In the developing, chronic lung diseases are mostly related to occupations. Leather industries are significant contributions to the nation's economy but they are potentially hazardous to the environment and to the workers, which causes health problems including chronic respiratory disease. Puducherry has small scale and medium scaled leather manufacturing units particularly in the urban zones yet there is lack of data of data on respiratory health conditions among leather workers in the region. Therefore, this study aims to assess the respiratory health implications among selected leather manufacturing workers in urban Puducherry. The findings will contribute to improving occupational health practices and promoting safer work environments in the local leather manufacturing sector related lung diseases. A cross sectional study was conducted after getting clearance from Scientific Research Committee and Institutional Human Ethics Committee in the Selected Leather Industry, where a total of 700 workers were employed. A face-to-face interview was conducted using pre-designed (pre-validated) questionnaire. A pre-calibrated portable spirometer enabled with Bluetooth connectivity was used to record the Spirometry measurements of the participants. The current study shows 64% of leather manufacturing workers in urban Puducherry showed abnormal pulmonary function, with 25% having moderate, 19% moderately severe, and 5% severe impairment. Only 4% reported using personal protective equipment, despite 49.2% having over 20 years of occupational exposure suggesting that age, along with the exposure at the workplace and BMI may cause increase in impaired pulmonary function and respiratory symptoms among leather factory workers. Medical examinations of the workers are recommended for screening and preventing function impairments. So, this kind of kind of will be help in early detection of the disease and further follow up will help prevention of diseases.

INTRODUCTION

Chronic Respiratory Diseases (CRDs) are a significant public health concern worldwide, particularly among industrial workers exposed to chemical and particulate pollutants. Globally, 27.1% of workers have any forms of respiratory symptoms.(1) The WHO Global Alliance against CRDs (GARD) vision is "a world in which all people breathe freely", focusing on the needs of people with CRDs in low- and middle-income countries.(2)

Occupational Safety and Health (OSH) is an important notion which can function as a particular line of defence for both employees and employers. Work-related diseases and injuries were responsible for the deaths of 1.9 million people in 2016, according to the first joint estimates from the World Health Organization (WHO) and International Labour Organization (ILO).(3) Nearly, 19 occupational risk factors, including exposure to long working hours and workplace exposure to air pollution, asthmagens, carcinogens, ergonomic risk factors, and noise. Workplace exposure to air pollution (particulate matter, gases and fumes) was responsible for 450,000 deaths which reduces productivity and can have a catastrophic impact on household incomes, the report warns.(4-6)

Occupational lung diseases remain under-recognized, under-reported life threatening health problems in developing countries. The International Labour Organization (ILO) stated work related diseases (30%) and death (10-20%) worldwide. Leather industries are potentially hazardous to environment as well as to the working population in this sector which may affect the health of the workers like musculoskeletal disorders, respiratory problems, skin diseases, infectious diseases, cancers, physical injuries and ocular problems.(7) India, being the top producers and exporters of leather and leather goods, contributes around 13% to global leather production. Over 4 million workers employed, many of whom work under poorly regulated conditions with limited access to personal protective equipment (PPE) and occupational health monitoring.

The Union Territory of Puducherry has a growing number of small-scale and medium-sized leather manufacturing units, particularly in its urban zones. Despite, there is a glaring absence of data on respiratory health conditions among leather workers in the region. While global and national studies have highlighted the adverse respiratory effects of working in leather industries, there remains a paucity of region-specific research, particularly in Puducherry. Therefore, this study aims to assess the respiratory health implications among selected leather manufacturing workers in urban Puducherry. The findings will contribute to improving occupational health practices and promoting safer work environments in the local leather manufacturing sector

MATERIALS AND METHODS:

After getting clearance from Scientific Research Committee and Institutional Human Ethics Committee, a cross-sectional study was conducted among workers in the Selected Leather Industry at Villianur, Puducherry. A total of 700 workers were employed in the leather industry.

Sample size was calculated using Yamane Formula, n = N/ 1 + [N *(e) ^2], with the confidence level 95%, Expected Frequency 50 % and Margin of error 6% Non – Response Rate. Therefore, the calculated sample size was 222.

Informed and written consent was obtained from the participants prior to the commencement of data collection procedure. A face-to-face interview was conducted using pre-designed (pre-validated) questionnaire. The questionnaire comprised of socio-demographic characteristics, personal habits, occupational details, usage of PPE kit and exposure to dust particles and health status of workers. The respiratory symptoms were then asked which includes acute and chronic cough with or without mucus, shortness of breath, wheezing, history of chronic bronchitis, asthma and respiratory-related health complaints.

A pre-calibrated portable spirometer enabled with Bluetooth connectivity was used to record the Spirometry measurements of the participants. Parameters like Forced Vital Capacity (FVC), Forced Expiratory Volume (FEV), Peak Expiratory Flow (PEF) and the ratio of FEV1/FVC were evaluated. All information related to the spirometry was saved in an android application linked to the instrument. The Principal Investigator was trained by a Senior Pulmonologist for performing the PFT and interpretation of the results. This was counter checked by the Pulmonologist. The details of the participants like age, gender, weight and height were entered in the Spirometer App and tests were performed according to standard procedure guidelines/ SOP. The PFT was performed three times for each participant and the best one was taken into account. Height and weight were measured by Stadiometer and electronic weighing scale after checking the calibrations.

STATISTICAL ANALYSIS:

All the statistical analyses were done using the SPSS software, version 23.0 (Armonk, NY: IBM Corp). The Kruskal-Wallis analysis was performed to know the variation in non-symmetric PFT values among the groups. Binary logistic regression analysis was performed to determine the influence of age, years of experience, BMI on PFT parameters. The p-value less than 0.05 were considered statistically significant for the concerned parameter.

RESULTS:

Table 1: Socio Demographic Characteristic of Study Population

Demographic Factors		Number (222)	Percentage (%)
Age (in years)	**21 - 30**	4	1.8
	31 - 40	68	30.6
	41 - 50	125	56.3
	51 - 60	25	11.3
Marital Status	**Unmarried**	12	5.4
	Married	207	93.2
	Widow	3	1.4
Gender	**Male**	6	2.7
	Female	216	97.3
Religion	**Hindu**	189	85.1
	Christian	30	13.5
	Muslim	3	1.4
Educational Status	**Primary**	13	5.9
	Middle	79	35.6
	High School	112	50.5
	Higher Secondary	12	5.4
	Graduate	6	2.7
Socio Economic Status (Modified BG Prasad Classification)	**Upper Class**	10	4.5
	Upper Middle	72	32.4
	Middle	76	34.2
	Lower Middle	62	27.9
	Lower Class	2	.9
Total no of Family Members	**< 4**	175	78.8
	> 4	47	21.2
History of Respiratory Disorder	**Yes**	17	7.7
	No	205	92.3
BMI (Asian Classification)	**Underweight**	2	.9
	Normal	21	9.5
	Over Weight	13	5.9
	Obese - 1	88	39.6
	Obese - 2	98	44.1
Work Experience (in years)	**1 - 5**	28	12.6
	6 - 10	29	13.1
	11 - 15	17	7.7
	16 - 20	39	17.6
	> 20	109	49.1
PPE	**Yes**	9	4.1

	No	213	95.9
Dust exposure	**Yes**	14	6.3
	No	208	93.7

Table 1 depicts on the socio demographic characters of the study population. Totally, 222 workers between the age of 20 and 60 years were examined during the survey. The mean age of the participants was 43.08 ± 6.0 years with the maximum number of workers fell in the age group of 41 – 50 years (56.3%). Majority of the respondents were married (93.2%) and the female respondents were more compared to male. About 85.1 % of them were Hindus by religion. According to Modified BG Prasad scales the respondents were found to be under middle class (34.2). The respondents (7.7%) were having previous history of respiratory symptoms. Almost half of the participants had education up to High school (50.5%). About 49.1% had work experience > 20 years. Based on Asian BMI classification, around 44.1% participants were in the category of obese – 2. About (4.1 %) of the respondents gave history of PPE kit usage and (6.3%) have exposure to the dust particles.

Table 2: Pulmonary function parameters of studied population.

Pulmonary function parameters	**Workers (N= 222)**	
	N (%)	**Mean (SD)**
FEV_1 % predicted > LLN >70 60 – 69 50 – 59 35 – 49	146 (58.4) 23 (9.2) 36 (14.4) 15 (6.0) 02 (0.8)	80.20 (14.14)
FVC % predicted > LLN >70 60 – 69 50 – 59 35 – 49	72 (28.8) 36 (14.4) 61 (24.4) 42 (16.8) 11 (4.4)	69.01 (12.44)
FEV_1/FVC Ratio % predicted < 70 % >70 %	02 (0.8) 221 (88.0)	95.67 (6.14)

Pulmonary function parameters

Table 2 describes the pulmonary function parameters. Based on the American Thoracic Society Grading, (based on FEV_1) severity of a Pulmonary Function Test abnormality were categorised with the help of portable spirometry. In this, FEV_1 % predicted, FVC % predicted, FEV1/FVC Ratio % predicted. About 58.4 % individuals have > 75% of Forced Expiratory FEV1, 72 % of the individuals have > 75 % of FVC, 88% of the individuals have > 70% of the FEV_1/FVC Ratio. The mean values of pulmonary function parameters in Leather workers were as FEV1 percentage predicted (80.20 ± 14.14), FVC percentage predicted (69.01 ± 12.44), and FEV1/FVC (95.67 ± 6.14).

Figure 1: Pulmonary function patterns among studied populations.

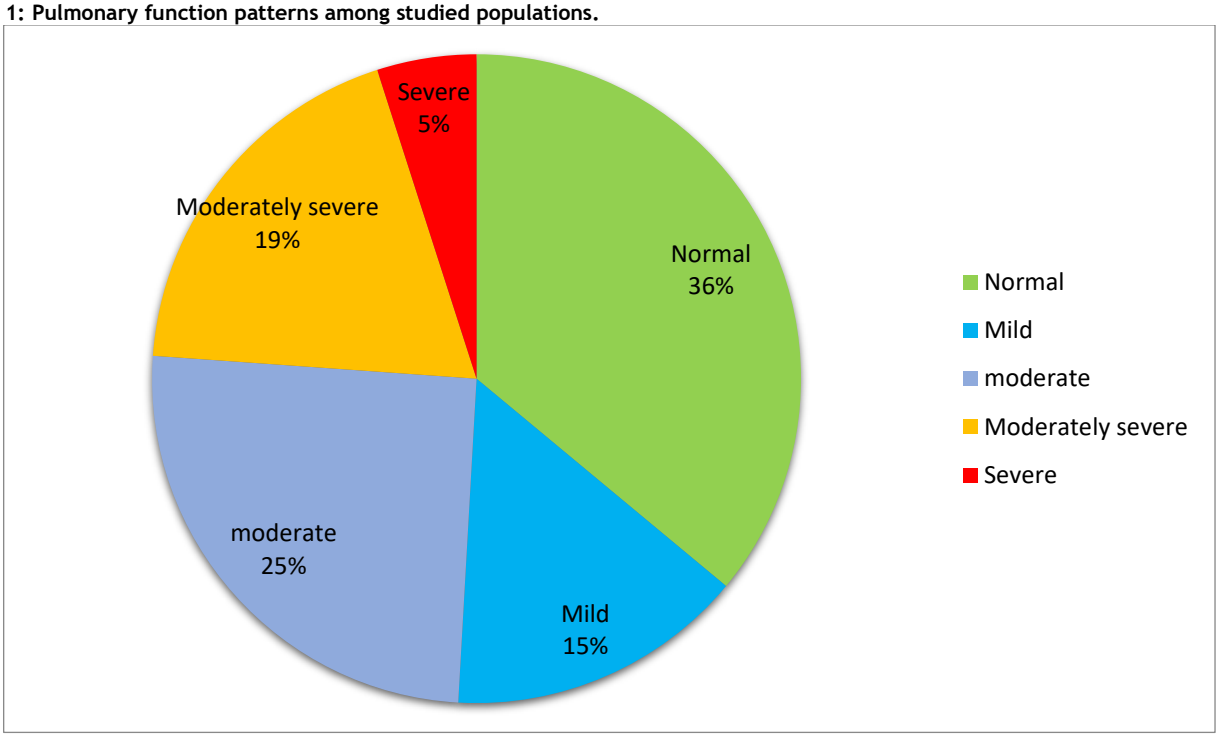

Figure 1: Shows the pulmonary function pattern among the studied population. About 36% of the study participants found under the normal category, about 5% of the individuals were found to have severe abnormality

.Table 3: Correlation between selected variables of socio- demographic profile and Pulmonary Function Parameter

Variables	r value	p- value
Age (in years)	-0.059	0.192
Work Experience (in years)	-0.137	0.020*
BMI	-0.141	0.018*

*p<0.05, statistically significant

Correlation between selected variables of socio- demographic profile and Pulmonary Function Parameter was given in table 3. Based on the correlation analysis between age, work experience, BMI and pulmonary function parameters there was a negative correlation. This implies as the work experience and BMI increases, the Pulmonary function of the participants decreases which was statistically significant.

Table 4: Linear regression selected variables of socio- demographic profile and Pulmonary Function Parameter

Variables	Coefficient (B)	t value	p-value	CI (95%)	
				Lower Bound	Upper Bound
Age	-.121	-.871	.385	-.394	.152
Work Experience	-.172	-2.059	0.041*	-.336	-0.007
BMI	-0.334	-2.119	0.035*	-0.023	-0.644

*p<0.05, statistically significant

Based on the Linear Regression analysis between age, work experience, BMI and pulmonary function parameters shows that work experience and BMI correlates negatively with duration of exposure as the r value was negative. Correlation was statistically significant for work experience and BMI. This was given in table 4.

DISCUSSION

The present study used to assess the respiratory health among selected leather factory workers and to determine the correlating factors with respiratory morbidities using portable spirometry. Workers of age group of 18 – 60 were taken as study participants. Where as in another study done by Muhammad Ateeqet al in pakistan taken the age group between 20 – 50 years.(8)

Among (222) the study participants, majority were fall under the age group of 41 – 50 with (56.3%) with the mean age of 43.08 ± 6.0. In my study, Female respondents were more than the male respondents where in study done by Ankur Khant et al in cotton industry of Rajkot have taken only male workers of age group between 30 – 55 years, wherein another study done by Rabiul Islam et al in Bangladesh has more male respondents than female, where in another study done by Sarmin Sultana et al in Bangladesh took workers working the tannery Industry as the study population irrespective of the age, sex.(9-11) In my study, Majority were married (93.2%). Similar to the study done by Asad Jamal et al in Karachi Pakistan (66%).(12)

About 85.1 % of them were Hindus by religion. Whereas the study done by Gyan Chandra Kashyap et al in Kanpur city shows majority were Muslims than Hindus.(13) The respondents were found to be under middle class according to modified B G Prasad classification. Where as in study conducted done by Rabiul Islam et al in Bangladesh classified socioeconomic status as < 8000, 8000 – 10000, 10000 – 12000, > 12000. Majority of the participants were under 8000 – 10000 as monthly income.(10) The respondents having respiratory symptoms were 7.7%. In the study done by Asad Jamal et al in Karachi Pakistan (20 %) of the participants were having respiratory symptoms.(12) Almost half of the participants were educated up to High school (50.5%). But in study Gyan Chandra Kashyap et al in Kanpur city shows more than half of the participants were illiterate same as study done by Rabiul Islam et al in Bangladesh majority of the participants were illiterate.(13,10) About 49.1% had work experience > 20 years, whereas the study done by Sarmin Sultana et al in Bangladesh participants has the work experience of > 10 years with 69.5%.(11)

Based on Asian BMI classifications, 44.1% of the participants were in the category of obese – 2, wherein Karunamoorthy P et al showed 55.4 % participants were normal by BMI.(7) Despite the known risks, only 4.1% of participants in this study reported consistent use of personal protective equipment (PPE), which is alarmingly low. Previous occupational studies from India by Chauhan et al confirm this trend, where lack of PPE use was linked with increased respiratory morbidity.(14) In contrast; industries with higher PPE compliance, such as shipbuilding and construction, report significantly lower prevalence of respiratory disorders.(15) Most of the tanner workers believed that they work in hazardous conditions; one of the hazardous conditions they mentioned is the dust exposure. In this study about (6.3%) have exposure to the dust particles; whereas the study in Bangladesh done by Sarmin Sultana et al had (19 %) have the dust exposure. (11)

According to American Thoracic Society Grading, In this study, FEV1 % predicted, FVC % predicted, FEV1/FVC Ratio % predicted. About 58.4 % individuals have > 75% of Forced Expiratory FEV1, 72 % of the individuals have > 75 % of FVC, 88% of the individuals have > 70% of the FEV1/FVC Ratio.

The mean values of pulmonary function parameters in Leather workers in this study is compared with the study in the Kasur conducted by Saleem i et al FEV1 percentage predicted (80.20 ± 14.14) where in others study shows FEV1 percentage predicted (89.61 ± 20.96), similarly, in the control group, the obtained mean values were FEV1 percentage predicted (96.48 ± 18.97). In this study FVC percentage predicted (69.01 ± 12.44), where FVC percentage predicted (88.45 ± 21.34), in control group FVC percentage predicted (92.94 ± 18.72) and In this study FEV1/FVC (95.67 ± 6.14), where in other study FEV1/FVC (0.87 ± 0.11) and in control group FEV1/FVC (0.86 ± 0.09). (16)

In this study shows that based on the correlation analysis between age, work experience, BMI and pulmonary function parameters there was a negative correlation. This implies as the work experience and BMI increases, the pulmonary function of the participants decreases which was statistically significant.

A significant negative correlation between work experience and pulmonary function (p = 0.041), as well as between BMI and pulmonary function (p = 0.035), was observed in the present study. This suggests that both cumulative dust exposure and increased adiposity contribute to declining lung performance. These findings are in line with Chattopadhyay et al who reported that goldsmiths occupationally exposed to metal fumes and fine particles demonstrated significant reductions in FEV_1, FVC, and PEFR with increasing years of exposure.(17) Additionally, increased BMI is known to reduce lung volumes due to altered respiratory mechanics and chest wall compliance.(18)

The study was conducted in the industrial complex of Deen Garh, Kasur city, Pakistan by Saleem I et al shows showed that age and job duration were negatively correlated with all pulmonary function parameters at the (0.01) and (0.05) significance level. The results of the point biserial correlation showed that respiratory symptoms were negatively correlated with all pulmonary function parameters FEV1 percentage predicted, FVC percentage predicted, and FEV1/FVC) at the (0.01) significance level. BMI and smoking status were not significantly correlated with the pulmonary function parameters.(16)

Based on the Linear Regression analysis between age, work experience, BMI and pulmonary function parameters shows that work experience and BMI correlates negatively with duration of exposure as the r value was negative. Correlation was statistically significant for work experience and BMI.

Age did not significantly correlate with outcome of spirometry in our study, possibly due to the relatively homogenous age distribution. However, other studies suggest that prolonged exposure to airborne hazards may exacerbate the normal age-related decline in lung function.(19,20) While only 8% of workers self-reported respiratory illness, over 60% were found to have abnormalities of spirometry. This discrepancy underlines the asymptomatic progression of occupational lung impairment, emphasizing the necessity for routine objective assessments, as reported in previous literature on leather and textile workers. (20,21)

CONCLUSION

The current study shows 64% of leather manufacturing workers in urban Puducherry showed abnormal pulmonary function, with 25% having moderate, 19% moderately severe, and 5% severe impairment. Only 4% reported using personal protective equipment, despite 49.2% having over 20 years of occupational exposure suggesting that age, along with the exposure at the workplace and BMI may cause increase in impaired pulmonary function and respiratory symptoms among leather factory workers. To prevent pulmonary function impairments, medical examinations of the workers periodically are recommended. This kind of screening will be helpful in early recognizing respiratory obstructions and further follow up for those participants having respiratory symptoms to be done. Also workplace health promotion programs focusing on physical activity can also be beneficial.

Strengths: of this study include the use of pre-calibrated portable spirometry which made the procedure easy, standardized protocol adherence with the inclusion of relevant occupational factors.

Limitations: The results obtained were based on self-reports from fewer numbers of participants. Hence results cannot be generalized for entire workers to show the actual prevalence. Being a cross-sectional study, environmental pollutant quantification and reliance on self-reported PPE use and symptoms cannot be done.

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