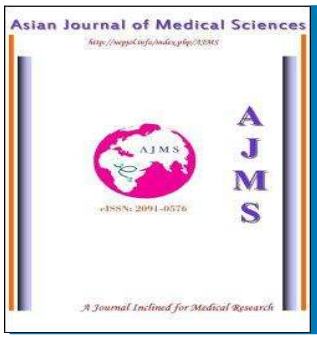


# OCCUPATIONAL EXPOSURE AND PULMONARY FUNCTION OF WORKERS OF CARPET INDUSTRIES AND SAWMILLS, LALITPUR, NEPAL

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*"Exposure to cotton and wood dusts lead to combined type of spirometric deficit."*

## ABSTRACT

**Background:** Most workers of carpet factory and sawmills suffer from non-specific lung diseases and ventilatory disorders. There is so many such industries operative in Lalitpur district and so far not many studies have been reported on pulmonary function in these workers.

**Method:** A brief clinical sheet regarding age, occupational particulars, smoking habits and presence or absence of major complaints was recorded for each worker. Spirometric parameters were recorded using an electronic (MEDSPIROR) spirometer. The groups consisted of control subjects not exposed to industrial dusts (n=50) for each group of workers (carpet factory, n=50 and saw mill, n=50).

**Result:** This study indicated an overall reduction in pulmonary function parameters; in particular FVC, FEV1 and FEV1/FVC % in carpet factory workers and FEV1 and FEV1/FVC % in saw mill workers. Comparison of pulmonary function parameters between carpet factories workers and sawmill workers revealed a significant reduction in $FEV_1$ and MVV in carpet workers.

**Conclusion:** Exposure to cotton dust and wood dust leads to combined type of spirometric deficit revealing obstructive or restrictive lung diseases. Workers exposed to industrial dusts also suffer from various upper or lower respiratory symptoms.

**Key words: Pulmonary function, Workers, Spirometry, Wood dust, Cotton dust.**

# INTRODUCTION

Air pollution is a major factor of aggravation of respiratory symptoms and diseases. Industrial dusts are major air pollutants in those environments. 'Respirable dusts' have adverse effects on pulmonary functions. Carpet industry and sawmills occupies a pivotal position in the economic dynamism of various countries including Nepal. The weavers in the carpet industries and sawmill workers suffer from various types of health risks factors. The risk in these industries is higher and ability to control it is lower. The majority of the problems are due to respirable dust, poor ergonomics, workstation design, and long hour of static working in the carpet industry.[1-4] Workers exposed to industrial dust suffer from various non-specific and specific lung diseases. There are several carpet factories and saw-mills in Lalitpur district which generate such fine suspended particles/dust and those industrial dusts can have adverse effect on pulmonary functions in exposed workers. The main objective of this study was to evaluate and compare pulmonary function parameters of workers of carpet industries and sawmills in Lalitpur, Nepal.

# MATERIALS AND METHODS

The present study was a cross-sectional comparative study. Subjects of experimental and control groups were selected by inclusion and exclusion criteria. There were two groups of experimental subjects (sawmill (n=50) and carpet workers (n=50)), who were non smokers and exposed to industrial dusts. And the subjects of control group were age matched, working in office set up, non smokers and not exposed to industrial dusts (n=100). A written consent signed by the subjects was obtained. Their height, weight, age, sex, presence of any respiratory symptoms/diseases, history of smoking and duration of exposure to dusts were documented using a standard case history sheet. Ambient temperature was also recorded. Weight was recorded in kg and height was measured in cm without shoes while standing erect. Pulmonary function parameters were recorded using an electronic spirometer (RSM, Medspiror, India). The spirometer was supplied with software which made correction for age, sex, weight, height and ambient temperature to given parameter. The subjects were briefed about the procedure of conduction of spirometry and demonstration was given before initiation of procedure. Using all aseptic techniques, the test was performed with nose closed by a nasal clip. The best of three readings were considered for analysis. Statistical analysis of data was performed using SPSS (version 18) and tested for normal distribution. The data of all the variables were expressed in terms of mean ± standard deviation. Student's t-test was used for comparison of all the variables between different groups. The result was considered statistically significant, if p-value < 0.05.

# RESULTS

The mean age of control subjects for carpet worker was 28.9 ± 4.03 years and mean weight and height were 55.2 ± 11.14 kg and 157.84 ± 8.49 cm respectively. The BMI of control subjects was 22 .06 ± 3.47 kg/m$^2$. The mean age of carpet workers was 30.6 ± 9.53 years and weight, height, and BMI were 59.54 ± 10.6 kg, 163.66 ± 8.11cm and 22.2 ± 3.45 kg/m$^2$ respectively (Table-1). The mean age of control subjects for sawmill worker was 23.36 ± 4.29 years and mean weight and height were 52.22 ± 8.89 kg and 162.68±8.67 cm respectively. The BMI of control subjects was 19.72 ± 2.9 kg/m$^2$. The mean age of sawmill workers was 25.88 ± 7.7 years and weight, height and BMI were 55.84 ± 9.72 kg, 161.84 ± 8.89cm and 21.26 ± 2.82 kg/m$^2$ respectively (Table-2). Most of the carpet workers (38%) were exposed to dust for 12-24 months whereas majority of sawmill workers (44%) exposed to wood dust were less than 6 months (Table-3). The major complaints among sawmill workers were cough (24%), abdominal discomfort (20%) ,skin allergy (6%), and sore throat (6%) whereas major symptoms reported by carpet factory workers were sore throat (6%), skin allergy (2%), backache (2%), and abdominal discomfort (2%).(Table-4). The mean FVC (Forced vital capacity), $FEV_1$ (Forced expiratory volume in one second), $FEV_1$/FVC (ratio between Forced expiratory volume in 1 second and Forced vital capacity), PEFR (Peak expiratory flow rate) and MVV (Maximum voluntary ventilation) were 3.11 ± 0.8 L, 2.91

Table1. Physical characteristics of control subjects and carpet workers

| Parameters | Control subjects (n=50) | Carpet workers (n=50) |
|---|---|---|
| | Mean ± SD | Mean ± SD |
| Age (Yrs) | 28.9 ± 4.03 | 30.6 ± 9.53 |
| Height (cm) | 157.84 ± 8.49 | 163.66 ± 8.11 |
| Weight (Kg) | 55.2 ± 11.14 | 59.54 ± 10.6 |
| BMI ($Kg/m^2$) | 22.06 ± 3.47 | 22.2 ± 3.45 |

Table 2. Physical characteristics of control subjects and sawmill workers

| Parameters | Control Subjects (n=50) | Saw mill workers (n=50) |
|---|---|---|
| | Mean ± SD | Mean ± SD |
| Age (Yrs) | 23.36 ± 4.29 | 25.88 ± 7.7 |
| Height (cm) | 162.68 ± 8.67 | 161.84 ± 8.89 |
| Weight (Kg) | 52.22 ± 8.89 | 55.84 ± 9.72 |
| BMI ($Kg/m^2$) | 19.72 ± 2.79 | 21.26 ± 2.82 |

Table3. Duration of dust exposure

| Duration (months) | Carpet workers (n=50) | | Sawmill workers (n=50) | |
|---|---|---|---|---|
| | No. of workers | % | No. of workers | % |
| < 6 | 6 | 12 | 22 | 44 |
| 6 – 12 | 12 | 24 | 15 | 30 |
| 12 – 24 | 19 | 38 | 13 | 26 |
| 24 – 36 | 3 | 6 | 0 | 0 |
| 36 – 48 | 2 | 4 | 0 | 0 |
| >48 | 8 | 16 | 0 | 0 |

Table 4. Chief complains of carpet factory and saw mill workers

| Chief complains | Carpet factory workers (n=50) | Sawmill workers (n=50) |
|---|---|---|
| Abdominal discomfort | 2 % | 20 % |
| Skin allergy | 2 % | 6 % |
| Sore throat | 6 % | 6 % |
| Cough | 2 % | 24 % |
| Backache | 2 % | 2 % |

120.42± 20.11L/min respectively in control subjects for carpet workers. The mean FVC, $FEV_1$, $FEV_1$/FVC, PEFR and MVV of carpet workers were 2.59 ± 0.67L, 2.09 ± 0.74L, 82.81 ± 22.09 %, 6.3 ± 2.2L/sec and 113.99 ± 22.63 L/min respectively (Table-5). The mean FVC, $FEV_1$, $FEV_1$/FVC, PEFR and MVV of control subjects for sawmill workers were 2.99 ± 0.95L, 2.82 ± 0.78L, 96.04 ± 7.61 %, 7.49 ± 1.85L/sec and 129.46 ± 24.99 L/min respectively whereas mean FVC, $FEV_1$, $FEV_1$/FVC, PEFR and MVV were 2.89 ± 1.1L, 2.48 ± 0.67L, 89.56 ± 16.77%, 7.05 ± 1.71L/sec and 126.37 ± 28.07 L/min in sawmill workers (Table-6).

# DISCUSSION

The main objective of this study was to evaluate the effect of exposure of dust on pulmonary function of workers of sawmills and carpet factories located in Lalitpur district. Determination of pulmonary function

Table 5. Pulmonary function parameters of control subjects and carpet workers

| Parameters | Control subjects (n=50) | Carpet workers (n=50) | p-value |
|---|---|---|---|
| | Mean ± SD | Mean ± SD | |
| FVC (L) | 3.11 ± 0.86 | 2.59 ± 0.67 | 0.001 |
| FEV1 (L) | 2.91 ± 0.45 | 2.09 ± 0.74 | 0.001 |
| FEV1/FVC (%) | 97.13 ± 4.7 | 82.81 ± 22.09 | 0.001 |
| PEFR (L/sec) | 6.44 ± 1.71 | 6.3 ± 2.2 | 0.723 |
| MVV (L/min) | 120.42 ± 20.11 | 113.99 ± 22.63 | 0.137 |

Table 6. Pulmonary function parameters of control subjects and sawmill workers

| Parameters | Control Subjects (n=50) | Saw mill workers (n=50) | p-value |
|---|---|---|---|
| | Mean ± SD | Mean ± SD | |
| FVC(L) | 2.99 ± 0.95 | 2.89 ± 1.1 | 0.641 |
| FEV1(L) | 2.82 ± 0.78 | 2.48 ± 0.67 | 0.02 |
| FEV1/FVC % | 96.04 ± 7.61 | 89.56 ± 16.77 | 0.016 |
| PEFR(L/sec) | 7.49 ± 1.85 | 7.05 ± 1.71 | 0.225 |
| MVV(L/min) | 129.46 ± 24.99 | 126.37 ± 28.07 | 0.562 |

Table 7. Pulmonary function parameters of carpet factory workers and sawmill workers

| Parameters | Carpet factory workers (n=50) | Sawmill workers (n=50) | p-value |
|---|---|---|---|
| | Mean ± SD | Mean ± SD | |
| FVC(L) | 2.59 ± 0.67 | 2.89 ± 1.1 | 0.096 |
| FEV1(L) | 2.09 ± 0.74 | 2.48 ± 0.67 | 0.008 |
| FEV1/FVC % | 82.81 ± 22.09 | 89.56 ± 16.77 | 0.092 |
| PEFR(L/sec) | 6.3 ± 2.2 | 7.05 ± 1.71 | 0.061 |
| MVV(L/min) | 113.99 ± 22.63 | 126.37 ± 28.07 | 0.018 |

revealed that FVC, $FEV_1$, $FEV_1$/FVC were significantly reduced, except PEFR and MVV in carpet factory workers. Ozesmi et al (1987) found significant reduction in $FEV_1$ and MMF in workers of carpet weaving factory.[5] Sangeeta (2012) showed a significant to highly significant variation in pulmonary function tests in workers of cotton dust workers.[6] The decrease in FVC and MVV indicates a restrictive impairment whereas decrease in ($FEV_1$), ($FEF_{25-75}$), (PEFR) indicates an obstructive impairment. But we have found a reduction in mean PEFR and MVV in carpet workers.

Pulmonary function parameters like FVC, $FEV_1$, $FEV_1$/FVC, PEFR and MVV were reduced, but only $FEV_1$ and $FEV_1$/FVC were significantly reduced in saw mill workers. Sultan A Meo (2006) found a significant reduction in the mean values of Forced vital capacity (FVC), Forced expiratory volume in one second ($FEV_1$), and Maximum voluntary ventilation (MVV) in wood workers relative to their matched controls.[7] Dudhmal et al (2006) observed that $FEV_1$ and PEFR were significantly decreased at 5% level of significance. However, FVC was not altered significantly while $FEV_1$ was significantly reduced, which is indicative of obstructive pulmonary disease.[8] The effect of occupational exposure to saw dust on lung functions of workers in various categories of work in the sawmill environment were investigated using Wright's Peak Expiratory flow meter. The result shows a significant ($p < 0.05$) dose and duration of exposure dependent decrease in the Peak expiratory flow rate (PEFR). [9]

Comparison of pulmonary function parameters between carpet factories workers and sawmill workers revealed a significant reduction in $FEV_1$ and MVV in carpet workers (Table-7). This is perhaps due to difference in nature of pathophysiological changes caused by cotton dust and wood dust. Usually there is mixed type of reduction in pulmonary function test among dust exposed population, but cotton dust are supposed to cause more restrictive type of changes whereas wood dust causes more obstructive lung diseases. In saw mill workers major health complaints was cough (24%), whereas sore throat in carpet workers (6%). About 20% of sawmill workers complained of abdominal discomfort. It is not clear whether it was related with ingestion of wood dust or frequent gastroenteritis due to unhygienic feeding habits among workers. And search of its clarification was beyond the scope of this study. This study indicated an overall reduction in pulmonary function parameters; in particular FVC, FEV1 and FEV1/FVC % in carpet factory workers and FEV1 and FEV1/FVC % in saw mill workers. Exposure to cotton dust and wood dust leads to combined type of spirometric deficit revealing obstructive or restrictive lung diseases. Workers exposed to industrial dusts also suffer from various upper or lower respiratory symptoms. Engineering control, industrial hygiene and health education are mandatory for dusty activities.

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**PKLD: Project writing, Data collection, Analysis of Data, Submission of final project report, writing of paper.**

**GBN: Project writing, Data collection, Analysis of Data, Submission of final project report, writing of paper**

**KUD: Project writing, Data collection.**

**RP: Data collection, Analysis of Data, Submission of final project report.**

**AB: Data collection, Analysis of Data, Submission of final project report.**

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