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Comparison of Pulmonary Function Tests among Females and Males Working at Construction Sites

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Abstract

Gender related differences in respiratory disorders have been documented. Respiratory disorder are seen in exposure to various types of occupational health hazards such as gases, fumes, inorganic and organic dusts which have risk factors in developing occupational lung diseases. Workers engaged in building and construction work are at risk of developing impaired lung function due to exposure to high level of dust generated at the construction site.

Aim: The aim of the study is to assess the gender related differences in pulmonary function test due to exposure at construction site to dust particle.

Materials and Method: The pulmonary function test was studied in 110 female construction workers and 110 male construction workers. The subjects were matched for age, height and weight. The Forced Vital Capacity (FVC) measured by simple spirometer and Peak Expiratory Flow Rate (PEFR) by Wright, peak flow meter and results were compared by Student's unpaired *t* test.

Results: the pulmonary function tests show significant decrease in observed FVC in female and male workers in group 3, 4 & 5, and %FVC in female worker in group 4 & 5 while in male worker in group 3, 4 & 5.

Significant decrease in PEFR in construction workers (female in group 4, 5, and in male 2, 3, 4, 5) in % PEFR in construction workers (female in group 3, 4, 5and male in group 2, 3 4, 5). Obstructive type of lung impairment was seen in female construction worker after 9years while in male worker before 9 years and development of restrictive type of lung impairment was observed in female after 15years and in male after 9 years.

Conclusion: Based on the results of the present study it may be concluded that male construction worker develop early impairment of pulmonary function in comparison to female construction workers.

***Keywords:**, FVC, %FVC, PEFR, %PEFR.*

Introduction

Gender differences in airway behavior and in the clinical manifestations of airway disease occur throughout the human lifespan.[1-5] Dust particles which are inhaled at construction site, lodges in the lung irritate and set up an inflammatory reaction. Healing of this inflammation causes fibrosis leading to defective oxygen diffusion and impaired lung function. [6] Cement dust initially causes mucous hyper secretion, followed by lung function impairment, chronic obstructive lung disease, restrictive lung disease, pneumoconiosis etc.[6,7]

In the workers exposed to a wide variety of organic dust, all men were more likely to exhibit early symptoms than women. [8] Gender differences in mortality rates for COPD is lower in women than in men. [9] Of India's 30 million construction labour, about half are women and account for 51% of total construction labour.[10] All

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construction sites produce dust, classified as PM-10.[11] In occupational respiratory diseases, spirometer is one of the most important diagnostic tool for the diagnosis and prognosis of the diseases and describes the effect of restriction or obstruction on lung function.[12]

The aim of the study is to assess the effect of construction site dust exposure on lung function of female and male workers and also see gender related differences in pulmonary function test by exposure of construction site dust particle.

Material and Method

This is the descriptive comparative study, undertaken in 220 healthy (female and male) worker in construction We have collected data of total number of 500 (male + female)workers. Out of them 110 were female and 110 male fit for the study, Contrl data was obtained from age matched 220 healthy male and females not engaged in construction work. Subject's age ranges from 26 years to 50 years which were divided in following age groups-group 1 =26-30 years, group 2=31-35 years, group 3=36-40 years, group 4 =41-45 years, group 5=46-50 years. In each group the duration of job was noted. Group 1=5 years, Group 2=9years, Group 3=15 years, Group 4=20 years and Group 5=25 years of job. In group 1number of cases (n) was =22, group 2 n=20, group 3 n=22, group 4 n=24, group 5 n=22 and equal number of control were taken for each subgroup.

Inclusion criteria-Subjects willing to participate in study and working in building construction throughout the year.

Exclusion criteria-Subjects with clinical abnormalities of vertebral column and thoracic cage, anemia, diabetes mellitus, hypertension, pulmonary tuberculosis and any abdominal or chest surgery were excluded from study.

The pulmonary function test, Forced Vital Capacity (FVC) was recorded by simple spirometer and Peak Expiratory Flow Rate (PEFR) with the help of Wright peak flow meter. Parameter taken in to account are observed FVC & PEFR, percent predicted (%) FVC and percent predicted (%) PEFR.

Subject's pulmonary status is diagnosed with restrictive impairment, based on the Forced Vital Capacity value below 80% of predictive value and diagnosis of obstructive impairment was based on a Peak Expiratory Flow Rate (PEFR) value below 75% of predictive value. [13] The subjects with Forced Vital Capacity value below 80% and Peak Expiratory Flow Rate (PEFR) value below 75% of predictive value were labeled as subjects with combined lung impairment. [13]

Statistical analysis =The data were analyzed by using the Statistical Package for Social Sciences (SPSS) version 10.0 programs for Windows. Unpaired Student's *t*-test, was applied. $p<0.05$ was considered as significant.

Results

The anthropometric data for the study female and male workers at construction site is represented in Table 1. The female and male construction workers were matched for age, height and weight with respective control.

Table 1A: Anthropometric data for the study female and male workers at construction site compared with control

Group	Exposed/ Non Exposed	Age (in years)	Height (cm)	Weight (Kg)	Exposed/ Non exposed	Age (years)	Height (cm)	weight (Kg)
Group-1 n= 22	Female construction workers	Mean=28.1 SD ±1.24 P>0.05	Mean=152.2 SD ±2.76 P>0.05	Mean= 50.5 SD ±2.03 P>0.05	Male construction worker	Mean=28.32 SD±2.31 p>0.05	Mean=162.8 SD±1.65 p>0.05	Mean=57.6 SD±1.89 p>0.05
	Control female	Mean=27.8 SD ±1.45	Mean=154.1 SD ±2.99	Mean=55.6 SD ±1.55	Male control	Mean=27.3 SD± 1.26	Mean=163.2 SD±1.48	Mean=58.35 SD±2.45
Group-2 n=20	Female construction workers	Mean=32.2 SD ±1.38 P>0.05	Mean=152.6 SD ±2.29 P>0.05	Mean=53.4 SD ±1.98 P>0.05	Male construction worker	Mean=34.35 SD±1.24 p>0.05	Mean=165.1 SD±1.56 p>0.05	Mean=62.2 SD±1.97 p>0.05
	Female control	Mean=33.0 SD ±1.51	Mean=154 SD ±1.6	Mean=54.7 SD ±1.9	Male control	Mean=33.35 SD±1.29	Mean=163.04 SD±1.58	Mean=62.75 SD±1.19

Group	Exposed/ Non Exposed	Age (in years)	Height (cm)	Weight (Kg)	Exposed/ Non exposed	Age (years)	Height (cm)	weight (Kg)
Group-3 n=22	Female construction workers	Mean=37.6 SD±1.63 P>0.05	Mean=154.0 SD±2.16 P>0.05	Mean=54.0 SD±2.04 P>0.05	Male construction worker	Mean=38.5 SD±1.23 p>0.05	Mean=163.8 SD±6.35 p>0.05	Mean=61.24 SD±4.05 p>0.05
	Female control	Mean=37.5 SD±1.5	Mean=152.8 SD±1.86	Mean=58.2 SD±1.91	Male control	Mean=37.5 SD±1.26	Mean=163.73 SD±3.85	Mean=63.5 SD±5.4
Group-4 n=24	Female construction workers	Mean=42.7 SD±1.28 P>0.05	Mean=151.0 SD±2.07 P>0.05	Mean=51.1 SD±3.65 P>0.05	Male construction worker	Mean=43.25 SD±2.03 p>0.05	Mean=163.1 SD±1.26 p>0.05	Mean=60.28 SD±3.36 p>0.05
	Female control	Mean=43.4 SD±1.28	Mean=151.3 SD±1.85	Mean=62.2 SD±3.10	Male control	Mean=42.36 SD±1.29	Mean=164.2 SD±2.25	Mean=63.5 SD±5.34
Group-5 n=22	Female construction workers	Mean=48.0 SD±1.77 P>0.05	Mean=152.8 SD±3.18 P>0.05	Mean=51.7 SD±2.31 P>0.05	Male construction worker	Mean=47.29 SD±2.36 p>0.05	Mean=162.8 SD±2.28 p>0.05	Mean=58.6 SD±3.23 p>0.05
	Female control	Mean=48.2 SD±1.45	Mean=152.5 SD±2.50	Mean=62.2 SD±3.15	Male control	Mean=48.26 SD±1.28	Mean=163.2 SD±2.23	Mean=60.2 SD±5.32

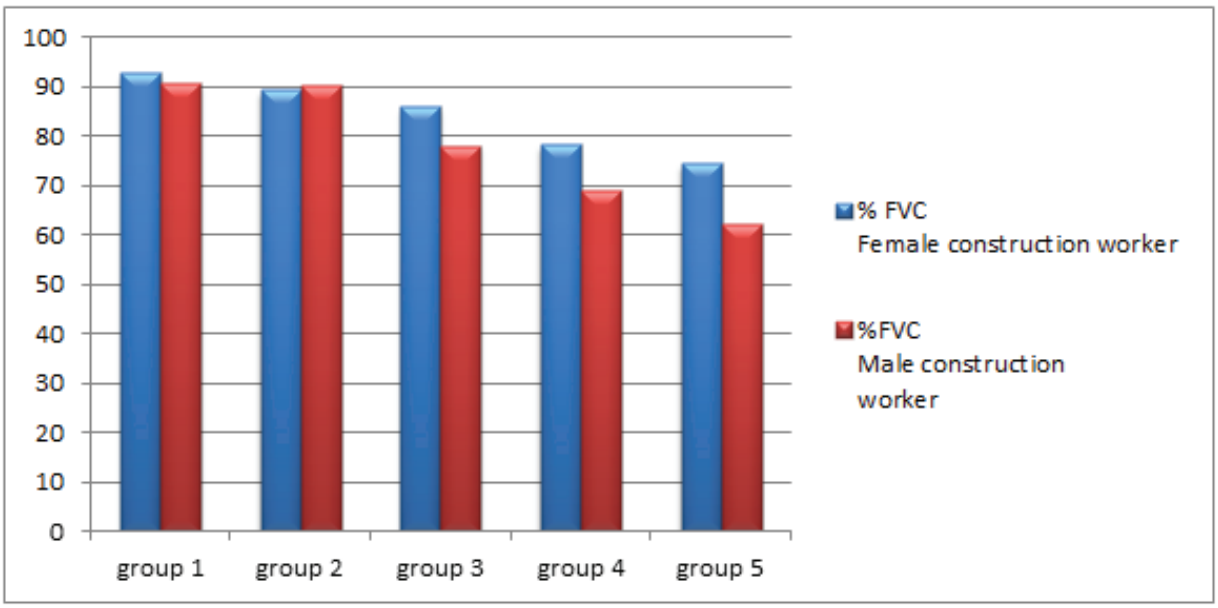
Values are mean ± SD. Sgnificance value ($P < 0.05$)

Table-2 shows the comparison of Forced Vital Capacity in different groups. In group 1 & 2, FVC in female construction workers are lower than the control. In group 3, 4&5 significant decrease in FVC & in group 4 and 5 highly significant decrease %FVC is seen (below 80%) i.e. suggestive of restrictive type of lung disorder, present in female construction workers with more than 15 years of duration of work. In male construction workers FVC&%FVC is significantly decrease in group 3, 4 &5. Compared with female % FVC, in male construction worker group 3, 4 &5 is low (below 80%) suggestive of early development of restrictive type of lung disease

Table 2: Forced Vital Capacity, % FVC in all groups compared with their matched controls

Group / Duration of work		FVC (ml) Female construction worker	FVC (ml) Female Control	% FVC Female construction worker	% FVC Female control	FVC (ml) Male control	FVC (ML) Male construction worker	%FVC Male control	%FVC Male construction worker
Group 1 5 years n= 22	Mean SD t = p value	2333±225.76 0.83>0.05	2416 ±199.14	92.8±9.26 0.144>0.05	93.4±8.3	3280±11	3080±50 1.55>0.05	97.35 ±4.43	90.6±6.62 0.09>0.05
Group 2 9 years n= 20	Mean SD t = p value	2201±223.71 1.67>0.05	2357 ±80.66	89.4±8.46 1.58>0.05	94.8±3.3	3180±80	3000±70 1.43>0.05	96.3 ±3.63	90.2±5.6 0.87>0.05
Group 3 15 years n= 22	Mean SD t = p value	2026±158.32 3.89<0.05	2293 ±58.5	85.9±7.46 3.53=0.05	96.1±1.57	3150±50	2730±70 3.88<0.001	93.15 ±4.95	78.1±5.78 6.23<0.001
Group 4 20 years n= 24	Mean SD t = p value	1731±212.69 5.81<0.001	2234 ±127.55	78.25±9.3 4.74<0.05	93.1±4.46	3100±42	2100±50 4.57<0.001	90.35 ±3.8	68.95±6.5 4.66<0.001
Group 5 25 years n=22	Mean SD t =p value	1583±237.29 6.28<0.001	2178 ±122.6	74.5±9.99 5.59<0.001	92.8 ±6.17	2800 ±90	2000±60 5.32<0.001	82.36 ±40	62.35±55 3.66<0.001

Values are mean± SD. Significant ($P < 0.05$); highly significant ($P < 0.001$)



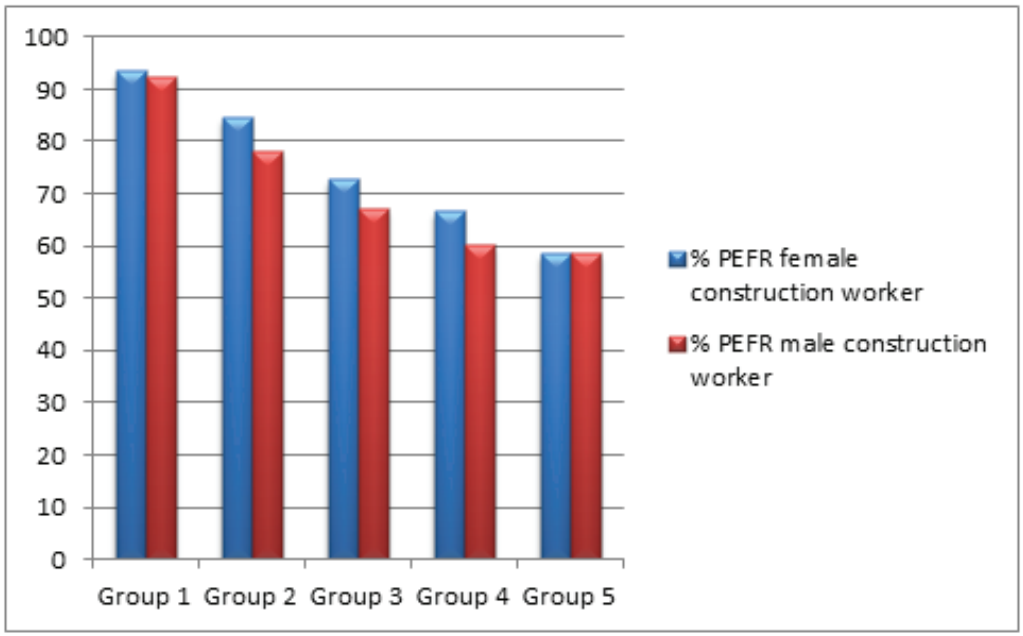
Graph: 1 Showing comparison of % Force Vital Capacity among male and female construction workers. Male workers of group 3 show % FVC < 80%.

Table 3: Comparison of PEFR, %PEFR in groups based on duration of constructioin work in compared with their age matched controls

Groups		Observed PEFR (ml/sec)				Percent predicted (%) PEFR			
		Female Control	Female Construction Worker	Male control	Male construction worker	Female construction worker	Female Control	Male control	Male construction worker
Group 1 n= 22	Mean SD t =p value	410 ±37.6	387±39.25 0.12>0.05	846±19	820±16 1.84>0.05	93.5±8.24 0.5>0.05	85.3 ±8.46	93.8±5	92.3±5.57 0.42>0.05
Group 2 n= 20	Mean SD t =p value	428 ±56.75	390±57.35 0.45>0.05	796±20	610±30 2.26 <0.05	84.5±11.9 1.32>0.05	86.2 ±11.63	88.1 ±4.2	78.0±8.9 8.52<0.001
Group 3 n= 22	Mean SD t =p value	397 ±13.45	336±38.8 1.87>0.05	770±60	550±12 5.26<0.001	72.8±9.5 1.33<0.05	86.7 ±2.23	88.5 ±5.6	67.1±11.2 9.89<0.001
Group 4 n= 24	Mean SD t =p value	331 ±34.82	285±40.36 2.51<0.05	700±45	490±20 6.21<0.001	66.6±12.3 2.42<0.05	79 ±7.89	85±2.3	60.2±10.3 8.36<0.001
Group 5 n=22	Mean SD t =p value	300 ±38.1	251±46.7 2.06<0.05	600±40	350±50 5.28<0.001	58.5±9.2 3.18<0.05	69.3 ±5.28	78±8.2	58.6±12.5 8.89<0.001

Values are mean± SD. Significant ($P < 0.05$); highly significant ($P < 0.001$).

Table-3 shows the comparison of Peak Expiratory Flow Rate, in different groups. In all the groups the observed PEFR and %PEFR in female and male construction workers were less than the control. In group 1, 2 and 3, this decrease was not significant but in group4 & 5 significant decreases in observed PEFR in female while in male construction worker significant decrease in group 2, 3, 4&5. In group 3, 4 and 5 statistically significant decrease were seen in % PEFR in female and in male from group 2. In group 3, 4 and 5, % PEFR below 75% of predictive value is suggestive of obstructive type of lung disorder occurring after 9 years of exposure and becomes worse even more as years of exposure is more than 9 years. Males have more significant decrease in comparison to female construction worker which starts earlier than in females.



Graph-2: Showing comparison of %PEFR among male and female construction workers.

Discussion

Gender differences in mortality rates for COPD lower in women than in men are reported for most industrialized countries. [9] Dust and cement particles inhaled are lodged in the lung causing lung irritation, mucus hyper secretion followed by lung function impairment, lung inflammation, chronic obstructive lung disease, restrictive lung disease, pneumoconiosis and so on. [6, 7, 13]

In this study, the pulmonary function tests show significant decrease in observed FVC in female and male workers in group 3, 4 & 5, and %FVC in female worker in group 4 & 5 while in male worker in group3, 4&5.

Significant decrease in PEFR in construction workers observed in higher duration of exposure to dust and cement particles in females has been reported in various studies measuring various respiratory variables. Similarly % PEFR in males was seen at lesser duration of exposure in contrast to female workers. Obstructive type of lung impairment was seen in female construction worker after 9years while in male worker before 9 years and restrictive type of lung impairment in female after 15 years and in male after 9 years. There is early development of obstructive and restrictive disease in male construction workers in comparison to female construction workers. These finding are concordance with earlier studies.

Little john's etal. Reported chronic bronchitis affected 17% of men but only 7% of women with wheezing in 9% of men and 3% women. [14] Walter and Richard reported significantly less FEV1 and FEF25-75 in Indian women than in men. [15] Jaen et al. found a higher prevalence of chronic bronchitis in men (21%) than in women (2.7%) as well as a higher prevalence of dyspnea (men: 11.4%; women: 9.8%) with clinically significant airflow limitation in 10.4% of men compared to 4.1% of women. [16, 17, 18]

In textile industry significant differences was seen in FVC with women having better lung function than men. [19] Oestradiol administration has shown improvement in asthma symptoms and dyspnoea index scores. [20]

Similar gender difference in tobacco smokers is reported in form of effects on women's pulmonary vasculature while in men it is their airways. [21] However, FEV1, FVC and FEV1/FVC% as a percentage of predicted are significant risk factors for mortality in both men and women. [22, 23]

Conclusion

The present study concluded that female and male workers at construction site shows decrease in FVC, %FVC, PEFR, %PEFR. and obstructive type of lung diseases develop early then long duration of work at construction site develops restrictive type of lung diseases. Male worker affected earlier in comparison to female construction worker.

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Conflict of Interest: None

Source of Funding: self

Ethical Clearance: By institutional ethics committee, GS Medical college & Hospital, Hapur

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