original article

Spirometric indicators of pulmonary function decline in males, chronically exposed to flour dust in bakery, confectionary and flour mills of Patiala (India).

Sanju Goel, Avnish Kumar, Jasjeet K Dhillon, KD Singh.

Abstract:

Background: Chronic exposure to flour dust has been implicated to the reduction of lung function. Pulmonary function tests are an important measure for the diagnosis and management of respiratory disorders. Workers in bakery, confectionary and flour mills are exposed to high amount of flour dust.

Objectives: To identify the changes in spirometric parameters in bakery, confectionary and flour mill workers of Patiala, Punjab (India).

Methods: The study was conducted in 200 non smoker males working in bakery, confectionary and flour mills and compared with 200 non smoker, non exposed males (Controls) from the same locality.

Results: Spirometric parameters were significantly reduced over a period of 10 year exposure to flour dust in males working in various food industries. The changes were evident over a 10 year exposure. The decline in lung function in subjects exposed for more than 10 years when compared to a 10 year exposure period was not significant.

Conclusion: Inhalation of industrial dust during work can lead to temporary or permanent changes in ventilator capacity. The decrease in pulmonary function is linked to years of exposure initially.

Key words: Flour dust, Pulmonary Function Test Spirometry.

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Introduction:

Evidence from studies reported from various parts of the globe document a decrease in lung function in workers exposed to organic dust in various industries[1,2,3].

Exposure to flour dust occurs across a range of food industries including bakeries, confectionaries and flour mills.Flour dust has been implicated in the decline of respiratory function in workers exposed to it in these three food industries[4,5,6].

The exposure of the flour dust on respiratory function is influenced by the dose and duration of exposure. Hence it may not be prudent to link the result of other studies to the one carried out in our food industry environment.

Pulmonary function tests are invaluable tool for screening and monitoring patients with outflow obstruction. Spirometry is the most important diagnostic tool in occupational disease and valuable for early detection even before clinical symptoms appear. Spirometric tests are relatively quick and simple to be performed and hence became a standard evaluation method in occupational health content.

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Key Word: Flour dust, Pulmonary, Function Test , Spirometry

The present study was undertaken to examine the respiratory function of workers exposed to flour dust working in bakery, confectionary and flour-mills in Patiala.

Materials and Methods:

The present study was carried out on 200 asymptomatic healthy male bakery, confectionary and flour mill workers of Patiala and 200 non-exposed non-smoker controls from the same area. 'Medspiror', a computerized Spirometer was used to assess various ventilator norms like FVC, FEV0.5%, FEV1, FEV3, PEFR, FEF25-75%, FEF25%, FEF50%, FEF75%, FEF0.2-1.2%, FEF.5/FVC%, FEV1/FVC%, FEV3/FVC%, MVV and to evaluate and compare the lung function status of the workers with that of the controls. Only two maneuvers were required to accumulate all test data, a forced vital capacity and a maximum voluntary ventilation. Detailed history of working in terms of nature of job and duration of exposure was taken. The two procedures were carried out and result were taken on a built in printer and calculated values of all 14 parameters were obtained.

Observation and Results:

The study includes the anthropometric data and spirometry record of 200 non smoker males working in bakeries, confectionaries and flour mills of Patiala and 200 healthy non smoking, non exposed subjects.

Table I – gives pulmonary function tests of bakery, confectionary and flour mill workers and controls. Data was analysed statistically using 't' test to compare functions of industrial workers and controls and to evaluate the occupational exposure deterioration in lung functions. On giving a cursory glance to the table it can be seen that lung capacities as well as flow rates showed a significant decrease in the exposed workers as compared to controls. In order to assess the contribution of flour dust, in causation of deterioration of pulmonary functions, the data was subjected to study of correlation coefficient (r) and 'p' value by taking height, age, weight, BSA of all subjects and duration of exposure to industrial dust as independent parameters and all the 14 lung function parameters as dependent parameters (Table 2).

Table 3 and Table 4 capture the results and comparison in a 5 year expose and a 10 years exposure group with controls.Table 5 compares the 10 year exposure subjects with more than 10 years exposure subjects.

It is clearly seen that the lung capacities as well as outflow rates show a significant decrease in exposed workers as compared with controls.

The decline in function was highly significant (-$p<0.005$) in exposed workers at 5 years of exposure and 10 years of exposure. The comparison of the group exposed to more than ten years showed a non significant decline ($p<0.01$) when compared with the 10 year exposure group.

TABLE -I: Pulmonary functions in workers and controls

Parameter N	Worker 200	Control 200	Worker/ Control 200/200
FVC(L)	2.96 ± 0.89	3.60 ± 0.66	HS ↓
$FEV_{0.5}$ (L)	1.27 ± 0.68	2.28 ± 0.55	HS ↓
FEV_{1} (L)	2.01 ± 0.86	3.26 ± 0.50	HS ↓
FEV_{3} (L)	2.84 ± 0.88	3.6 ± 0.50	HS ↓
PEFR (L/s)	4.13 ± 2.39	7.77 ± 1.55	HS ↓
$FEF_{25-75\%}$ (L/s)	2.12 ± 1.15	4.05 ± 0.82	HS ↓
$FEF_{0.2-1.2\%}$ (L/s)	3.37 ± 1.91	6.87 ± 1.46	HS ↓
$FEF_{25\%}$ (L/s)	3.51 ± 1.93	6.99 ± 1.34	HS ↓
$FEF_{50\%}$ (L/s)	2.40 ± 1.29	4.65 ± 1.08	HS ↓
$FEF_{75\%}$ (L/s)	1.48 ± 0.99	2.33 ± 0.94	HS ↓
$FEV_{.5}$/ FVC (L/s)	45.46 ± 21.99	69.35 ± 18.16	HS ↓
FEV_{1} /FVC (L/s)	69.92 ± 22.65	90.05 ± 5.48	HS ↓
FEV_{3} /FVC (L/s)	95.90 ± 9.12	99.98 ± 0.20	HS ↓
MVV (L/minute)	102.10 ± 32.76	129.69 ± 32.17	HS ↓

TABLE -2: Showing simple correction coefficient for bakery, confectionary & flour mill workers

Parameter N	Yrs. of Exp	HT	Age (yrs.)	Wt.	BSA
FVC	-.333**	.428**	-.183*	.265**	.362**
$FEV_{0.5}$	-.43**	.312**	-.144#	.21*	.28**
FEV_{1}	-.47**	.354**	-.167#	.21**	.295**
FEV_{3}	-.40**	.399**	-.24**	.21**	.31**
PEFR	-.369**	.196*	-.108#	.216**	.24**
$FEF_{25-75\%}$	-.44**	.211**	-.181*	.114#	.17#
$FEF_{0.2-1.2\%}$	-.43**	.31**	-.163#	.273**	.33**
$FEF_{25\%}$	-.43**	.25**	-.148#	.228**	.271**
$FEF_{50\%}$	-.43**	.19*	-.166#	.130#	.175#
$FEF_{75\%}$	-.32**	0.05#	-.243**	-.051#	-.020#
$\frac{FEV_{.5\%}}{FVC}$	-2.1**	.09#	-.019#	.078#	.092#
FEV_{1} /FVC	-.25**	0.25#	-.014#	0.73#	.064#
FEV_{3} /FVC	-.19*	-.057#	-.123#	-.136#	-.13#
MVV	-.232**	.33**	-.193*	.110#	.207**

** ? Highly significant - $p < 0.005$ * ? significant $0.005 < p < 0.01$ # ? Not significant $p < 0.01$

TABLE -3: Showing mean, standard deviation and 't' values with statistical significant between controls & bakery, confectionary & flour mill workers with 0-5 years of service.

Parameter	Control n=200		Workers n=85		't' value	Significance
	Mean	SD	Mean	SD		
FVC	3.60	0.66	3.27	0.92	3.47	HS
$FEV_{0.5}$	2.28	0.55	1.66	0.70	7.98	HS
FEV_{1}	3.26	0.50	2.50	0.87	9.28	HS
FEV_{3}	3.60	0.66	3.21	0.93	4.07	HS
PEFR	7.77	1.55	5.25	2.45	10.49	HS
$FEF_{25-75\%}$	4.05	0.82	2.77	1.13	10.79	HS
$FEF_{0.2-1.2\%}$	6.87	1.46	4.33	1.99	11.83	HS
$FEF_{25\%}$	6.99	1.34	4.48	2.00	12.39	HS
$FEF_{50\%}$	4.65	1.08	3.12	1.21	10.54	HS
$FEF_{75\%}$	2.33	0.94	1.94	1.16	2.95	HS
$\frac{FEV_{.5\%}}{FVC}$	69.35	18.06	52.92	21.24	6.63	HS
FEV_{1} /FVC	90.05	5.48	79.08	17.26	8.08	HS
FEV_{3} /FVC	99.98	0.20	97.81	6.45	4.76	HS
MVV	129.69	32.17	110.79	34.33	4.42	HS

HS ? Highly significant - $p < 0.005$, S ? Significant $0.005 < p < 0.01$

NS →Not significant $p<0.01$

TABLE -4: Showing mean, standard deviation and 't' values with statistical significant between controls & bakery, confectionary & flour mill workers with 0-5 years of service and 6-10 years of service:

Parameter	Industrial workers 0-5 yrs. n= 85		Industrial workers 6-10 yrs n =77		't' value	Significant
	Mean	SD	Mean	SD		
FVC	3.27	0.92	2.75	0.75	3.93	HS
$FEV_{0.5}$	1.66	0.70	1.07	0.52	5.99	HS
FEV_{1}	2.50	0.87	1.78	0.70	5.85	HS
FEV_{3}	3.21	0.93	2.64	0.72	4.32	HS
PEFR	5.25	2.45	3.48	1.94	5.07	HS
$FEF_{25-75\%}$	2.77	1.13	1.74	0.97	6.24	HS
$FEF_{0.2-1.2\ \%}$	4.33	1.99	2.62	1.30	5.99	HS
$FEF_{25\%}$	4.48	2.00	2.87	1.43	5.63	HS
$FEF_{50\%}$	3.12	1.21	1.97	1.09	6.29	HS
$FEF_{75\%}$	1.94	1.16	1.18	0.66	5.08	HS
$\frac{FEV_{.5\%}}{FVC}$	52.92	21.24	41.39	19.30	3.59	HS
FEV_1 /FVC	79.08	17.26	64.96	22.00	4.56	HS
FEV_3 /FVC	97.81	6.45	95.85	9.28	1.57	HS
MVV	110.79	34.33	95.08	28.92	3.14	HS

HS ? Highly significant $p < 0.005$, S ? Significant $0.005 < p < 0.01$, NS ? Not significant $p < 0.01$

TABLE -5: Showing mean, standard deviation and 't' values with statistical significant between controls & bakery, confectionary & flour mill workers with 6-10 years of service and more than10 years of service:

Parameter	Industrial workers 6-10 yrs. n= 77		Industrial workers 10 yrs n =38		't' value	Significant
	Mean	SD	Mean	SD		
FVC	2.75	0.75	2.70	0.92	.303	NS
$FEV_{0.5}$	1.07	0.52	0.83	0.44	2.40	S
FEV_{1}	1.78	0.70	1.42	0.51	2.8	NS
FEV_{3}	2.64	0.72	2.43	0.77	1.46	NS
PEFR	3.48	1.94	2.97	2.07	1.28	NS
$FEF_{25-75\%}$	1.74	0.97	1.45	0.78	1.61	NS
$FEF_{0.2-1.2\ \%}$	2.62	1.30	2.27	1.49	1.12	NS
$FEF_{25\%}$	2.87	1.49	2.35	1.41	1.68	NS
$FEF_{50\%}$	1.97	1.41	1.68	1.01	1.39	NS
$FEF_{75\%}$	1.18	1.01	1.04	0.75	1.03	NS
$\frac{FEV_{.5\%}}{FVC}$	41.39	37	37	24.08	1.05	NS
FEV_1 /FVC	64.96	59.57	59.57	27.20	1.14	NS
FEV_3 /FVC	95.85	91.70	91.70	12.26	2.01	NS
MVV	95.08	97.29	97.29	32.99	-0.37	NS

HS ? Highly significant - $p < 0.005$, S ? Significant $0.005 < p < 0.01$, NS? Not significant $p < 0.01$

Discussion

Exposure to flour dust occurs in a wide range of industries which include rice mills, bakeries ,flour mills and confectionaries. Constant exposure to flour dust puts the workers at increased risk of acute and chronic respiratory disease. Occupational exposure to floor dust has shown a significant decrease in lung function parameters elsewhere[8-10]. Similar observations have been reported from India[11-13].

Our results are in conformity with the above reports in that there is an undisputed decline in pulmonary function in workers exposed to flour dust in various food industries.

The exposure to floor dust and decline in respiratory function and appearance of clinical disease are influenced not only by the dose and duration of exposure but many other factors as detailed by Agata Stobnicka and Rafal L Gormy[14].

Our study presented subjects who show a significant decline in pulmonary function upto 10 years of exposure. There was no significant decline in the pulmonary function when comparison was made between 10 year exposure and those with more than 10 years exposure (Table 5)

Hamdy et al has reported a continuous decline in respiratory function even after 10 years of exposure[15].

The determinants of exposure leading to a decline in pulmonary function in workforce exposed to flour dust are linked to the dose and duration of exposure no doubt, but other factors like the source of the flour dust , the size of the particles, the size of the production enterprise, type of food industry, personal protection methods employed must be contributing factors[14].

Non regulation of work hours, low hygienic atmosphere in workplace ,and inability to dose titration (not quantified in this study) may be additional factors contributing to decrease in function in our workers as compared to those in more developed countries , facing the same environmental challenges.

Conclusion:

There is a growing consensus that workers exposed to environment pollutants in the workplace show a significant decrease in pulmonary function linked to the number of years of exposure. Same is true in workers exposed to flour dust in industries like ,bakeries ,confectioneries and flour mills. The decrease in function starts very early and continues to decline overtime. It becomes imperative to have preventive measures(Personal protection – masks ,gloves etc.) in place in all these occupational hazard industries to arrest or delay the development of environmental disease in people working there.

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