

## TRANSFER LUNG FACTOR FOR CO (TLCO) AND ITS COMPONENTS (DM & VC) IN FLOUR MILL WORKERS

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**Abstract :** TLCO, KCO (TLCO/Va), Va, Vc and Dm were measured in 25 flour mill workers (non-smoker 9, smoker 16) and 50 healthy control subjects (25 non-smoker, 25 smoker) of similar anthropometric parameters and socio-economic status. TLCO ( $P<0.05$ ) was decreased significantly and rest of the parameters were decreased insignificantly in flour mill workers as compared to control subjects. In non-smoker flour mill workers none of the parameters altered significantly as compared to non-smoker control subjects. Statistically significant reduction was seen in smoker workers only in TLCO ( $P<0.05$ ) and its component Dm ( $P<0.05$ ) as compared to smoker control subjects. Further it has been observed that less duration of flour dust exposure (<5 years) in all flour mill workers and smoker flour mill workers caused negligible fall in TLCO, whereas longer duration of flour dust exposure (>5 years) in both the groups caused highly significant fall in TLCO ( $P<0.01$ ) which was contributed to by highly significant fall in Dm ( $P<0.001$ ).

**Key words :** flour dust      transfer lung factor      Dm      Vc

### INTRODUCTION

Industrial dust inhalation over a long period leads to fibrotic and proliferative changes in the lungs (1). Reduction in ventilatory functions is reported in workers of different industries (2, 3, 4). Recently reduction in diffusing capacity for carbon monoxide in asbestos workers (5, 6) begasse workers (7) and bauxite workers (8) has been observed. Reduction in lung transfer factor has been reported in healthy smoker subjects as compared to non-smokers (9, 10). Clinical use of TLCO and its component Dm in fibrotic lung disease has been suggested by some workers (11, 12, 13). They observed reduction in TLCO in fibrotic lung disease, this was only contributed by decrease in membrane diffusion component. Vc was either slightly decreased or not affected. Reduction in TLCO in smoker flour mill workers is already reported from this laboratory (14). Present study is an extension of the same work to find out the

role of membrane diffusion component and pulmonary capillary blood volume in deterioration of TLCO in smoker flour mill workers and better analysis of TLCO in relation to flour dust exposure.

### METHODS

The study was conducted in 25 healthy flour mill (Atta Chakki) workers (16 smokers, 9 non-smokers) and 50 healthy control subjects (25 smoker, 25 non-smoker) who were not exposed to flour dust. All the subjects were having similar physical characteristics (Table I) and socio-economic status. All the subjects were clinically and radiologically free from any cardiopulmonary disease or any other disease which could hinder with performance of the tests. Detailed history of working, in terms of daily working hours and period of working at flour mill was recorded.

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TABLE I : Physical characteristics of various subjects

S.No.	Parameter	Control Non-smokers	Control smokers	Flour Mill workers (Smoker + Non-smoker)
	0	25	25	25
1.	Age (year)	29.92±8.10	29.52±6.83	30.76±9.22
2.	Height (meter)	1.69±0.06	1.68±0.04	1.66±0.05
3.	Weight (kg)	59.72±8.14	54.96±8.99	55.84±10.51
4.	Surface area (m <sup>2</sup> )	1.68±0.12	1.62±0.13	1.61±0.14

Value = Mean ± SD

Subjects were asked to abstain from smoking for at least 2 hr before reporting to the laboratory. Each subject was explained about the method of the test to eliminate fear and apprehension. All the tests were performed between 9 A.M. to 11 A.M. in winter months but room temperature was maintained between 20° to 26°C. Morgan transfer test Model 'C' and Computer Magna '88' (PK Morgan, Chanthan, Kant UK) were used to study and analyse the data. Morgan transfer test Model 'C' was principally made up of 'dry' seal spirometer, carbon monoxide infra red meter, helium spectrometer and O<sub>2</sub> paramagnetic analyser. Transfer lung factor for carbon monoxide (Tlco), Tlco high (Tlco H) alveolar volume (Va), diffusion coefficient for Co (Kco), membrane diffusion (Dm) and pulmonary capillary blood volume (Vc) were estimated in all the subjects. The standard single breath technique (15) was used to measure Tlco and Tlco H. Tlco and Tlco H are the transfer lung factors for Co measured at low O<sub>2</sub> concentration (18%) and high O<sub>2</sub> concentration (85%) in test gases respectively. Dm and Vc were calculated from their graphical records. All the data was statistically analysed by using unpaired 't' test.

## RESULTS

Out of 25 flour mill workers, 16 were smokers and 9 were non-smokers. The daily working hours of flour mill workers ranged from 4 to 10 hours. To avoid this wide range the exact duration of flour dust exposure was found out as follows :

One flour dust exposure = 8 hours of working at flour mill in a day

$$\text{Duration of flour dust exposure} = \frac{\text{No. of working hrs daily}}{8} \times \text{working duration (in years)}$$

The duration of flour dust exposure of total flour mill workers was 6.91±4.76 years, and ranged from 2.5 to 20.25 years. Smoker workers were exposed more to flour dust (7.8±5.1 years) as compared to non-smoker workers (5.32±3.82 years).

The pulmonary functions tests done in flour mill workers and in control subjects are given in Table II, III and IV. Lung functions tests of all the flour mill workers (NS + S) were compared with those of all control subjects (NS + S). Their statistical analysis is given in Table II. Depending upon less or more duration of flour dust exposure, flour mill workers were divided in two groups irrespective of smoking habit and all the tests of these two groups were compared with total control subjects (NS + S) (Table II).

In order to study as to whether smoking *per se* has affected the diffusion capacity and its component, data of smoker flour mill workers were separated out and compared with non-smoker flour mill workers (Table III). As it is known that smoking reduces the transfer lung factor (9, 10), the data of smoker and non-smoker flour mill workers were compared with their respective control subjects to study the effect of flour dust in them (Table III, IV). To study the effect of duration of flour dust exposure in smokers, they were divided in two groups < 5 years of duration of exposure (7 subjects) and > 5 years of duration of exposure (9 subjects). Each group was compared with smoker control subjects (Table IV).

TABLE II : The data and statistical analysis of lung functions of flour mill workers (FMWs) and control subjects.

S. No.	Parameters	I		2		3	
		Control (NS+S)	FMWs (NS+S)	Control (NS+S)	FMWs (NS+S) <5 years of flour dust exposure	Control	FMWs (NS+S) >5 years of flour dust exposure
n		50	25	50	13	50	12
1.	Tlco (ml/min/mmHg)	30.49±4.13	27.54±6.08*	30.49±4.13	30.18±6.74	30.49±4.13	25.77±6.31**
2.	Tlco H (ml/min/mmHg)	13.7±2.64	12.94±3.29	13.7±2.64	13.62±3.38	13.7±2.64	12.27±3.21
3.	Va (L)	5.02±0.53	5.01±0.68	5.02±0.53	5.1±0.5	5.02±0.53	4.92±0.86
4.	KCO (Tlco/Va)	6.08±0.75	5.62±1.2	6.08±0.75	5.74±1.19	6.08±0.75	5.32±1.22*
5.	Dm (ml/min/mmHg)	57.86±13.34	50.37±14.52*	57.86±13.34	64.59±24.25	57.86±13.34	42.55±10.38***
6.	Vc (ml/min)	65.42±13.28	63.49±19.48	65.42±13.28	64.29±19.18	65.42±13.28	62.68±20.71
Effect of flour dust				Effect of short duration of exposure		Effect of longer duration of exposure	

Values = Mean ± S.D.

S = Smoker

NS = Non-smoker

\* = P&lt;0.05

\*\* = P&lt;0.01

\*\*\* = P&lt;0.001

TABLE III : The data and statistical analysis of lung functions of flour mill workers (FMWs) and control subjects.

S. No.	Parameters	I		2	
		FMWs (NS) 9	FMWs (S) 16	Control (NS) 25	FMWs (NS) 9
1.	Tlco (ml/min/mmHg)	30.5±6.09	5.45±5.6*	31.54±4.24	30.5±6.09
2.	Tlco H (ml/min/mmHg)	12.89±2.75	12.98±3.68	14.88±2.75	12.89±2.75
3.	Va (L)	5.21±0.94	4.97±0.52	5.01±0.62	5.21±0.94
4.	KCO (Tlco/Va)	5.9±1.0	5.46±1.32	6.29±0.78	5.9±1.0
5.	Dm (ml/min/mmHg)	65.91±30.83	47.76±11.81	55.33±11.14	65.91±30.83
6.	Vc (ml/min)	61.82±15.88	64.31±21.66	70.42±11.87	61.82±11.88
Effect of smoking				Effect of flour dust	

Values = Mean ± SD

S = Smoker

NS = Non-smoker

\* = P&lt;0.05

TABLE IV : The data and statistical analysis of lung functions of smoker flour mill workers (FMWs) and control subjects.

S. No.	Parameters	I		2		3	
		Control (S)	FMWs(S)	Control (S)	FMWs (S) <5 years of flour dust exposure	Control (S)	FMWs (S) >5 years of exposure
n		25	16	25	7	25	9
1.	Tlco (ml/min/mmHg)	29.45±3.83	25.45±5.6*	29.45±3.83	27.4±8.35	29.45±3.83	24.37±4.45**
2.	Tlco H (ml/min/mmHg)	12.56±1.99	12.98±3.68	12.56±1.99	13.15±4.36	12.56±1.99	12.94±3.4
3.	Va (L)	5.12±0.53	4.97±0.52	5.12±0.53	4.96±0.5	5.12±0.53	4.87±0.54
4.	KCO (Tlco/Va)	5.76±0.6	5.46±1.32	5.76±0.6	5.49±1.42	5.76±0.6	5.44±1.32
5.	Dm (ml/min/mmHg)	61.35±23.53	47.76±11.81*	61.35±23.53	51.98±13.87	61.35±23.53	42.94±8.76***
6.	Vc (ml/min)	60.17±13.47	64.31±21.66	60.17±13.47	63.04±23.29	60.17±13.47	61.89±20.69
Effect of flour dust				Effect of short duration of exposure		Effect of longer duration of exposure	

Values = Mean ± S.D.

S = Smoker

\* = P&lt;0.05,

\*\* = P&lt;0.01,

\*\*\* = P&lt;0.001

## DISCUSSION

On comparison of lung function tests of 25 flour mill workers (NS + S) with 50 control subjects (NS + S), it was seen that Tlco ( $P<0.05$ ) and Dm ( $P<0.05$ ) were decreased significantly and rest of the parameters, Va, KCO and Vc decreased insignificantly (Table II) in flour mill workers. This shows that flour dust exposure in workers cause deterioration of transfer lung factor (Tlco). This is also reported by some other investigators in Asbestos workers (6), Bagasse workers (7) and in Bauxite workers (8).

To study the effect of duration of flour dust exposure, the lung function tests of the two groups of flour mill workers depending on duration of flour dust exposure were compared with all the control subjects which revealed that less than 5 years of exposure to flour dust caused negligible changes in the parameters studied (Table II) but more than 5 years duration of flour dust exposure caused highly significant fall in Tlco ( $P<0.01$ ) and Dm ( $P<0.001$ ) whereas Va and Vc decreased insignificantly (Table II). From this comparison it is clear that only the longer duration of flour dust exposure caused a significant fall in Tlco in workers and this was contributed to by a significant fall in the Dm.

Table III shows that the Tlco is significantly lower ( $P<0.05$ ) in smoker workers as compared to non-smoker workers. Similar findings have been reported in smokers by others (9,10). The comparison of lung functions of non-smoker flour mill workers with control subjects revealed insignificant fall in all the parameters (Table III). It is probably because of less duration of flour dust exposure ( $5.32\pm3.82$  years) of these subjects or

insufficient number (9) of the subjects. Whereas the comparison of lung functions of smoker workers with smoker control subjects revealed that there is significant deterioration of Tlco ( $P<0.05$ ) and Dm ( $P<0.05$ ) (Table IV). This deterioration is possibly because of flour dust exposure. The significantly low Tlco and Dm, only in smoker workers indicated that smoking habit of the workers acted as a precipitating factor to the damaging effect of flour dust.

The less duration (<5 years) of flour dust exposure in smoker workers shows insignificant fall in all the parameters (Table IV) while more duration (>5 years) of flour dust exposure shows highly significant fall in Tlco ( $P<0.01$ ) and Dm ( $P<0.001$ ), though other parameters decreased insignificantly. The highly significant fall in Tlco and Dm with longer duration of flour dust exposure stresses the importance of duration of working at the flour mill. It also suggests that smoking for longer duration in these subjects might have enhanced the damage induced by the flour dust because of longer duration of exposure.

## CONCLUSION

From the present study it may be concluded that flour dust exposure causes some kind of changes in respiratory membrane of the lungs as seen in other relevant studies (11, 12) in smoker workers but not in non-smoker workers. These changes are more prominent in workers who were exposed to flour dust for longer duration. Above finding in smoker workers may also suggest that smoking habit is a precipitating factor for the damaging effect of flour dust and the damage is further enhanced by smoking for longer duration.

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