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PEAK EXPIRATORY FLOW RATE IN FLOUR MILL WORKERS

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Abstract : The current cross-sectional study with a comparison group was undertaken to investigate peak expiratory flow rate (PEFR) in flour mill workers and to study relationship between reduction in PEFR and age, smoking, exposure to grain dust and respiratory morbidity. The study included 286 flour mill workers and equal number of neighbourhood controls group-matched for age.PEFR was measured by using Wright's Peak Flow Meter. PEFR was significantly reduced in flour mill workers as compared to comparison group. The decline in PEFR was significantly associated with grain dust exposure, duration of exposure, tobacco smoking and presence of respiratory morbidity.

Key words : flour mill workers PEFR respiratory morbidity grain dust exposure

INTRODUCTION

The International Symposium on the Effects of Grain Dust on Human Health held at the University of Saskatchewan during 7-9 November 1977 has endorsed the respiratory effects of exposure to grain dust and impairment of lung function among flour mill workers (1). Since then studies of respiratory morbidity and lung function assessment have been performed among workers from various occupations where exposure to grain dust is encountered which included dock workers, grain storage workers; longshoremen, flour mill workers, grain transporters and bakers in different parts of the world (1-4).

However, the results of previous studies are inconsistent, particularly in relation to lung function impairment in flour mill workers (1-6). With this background and fortified by the fact that no comprehensive literature is available on lung function assessment in flour mill workers across the country including Central India and considering unorganized nature of this industry, we have carried out a cross-sectional study with a comparison group to investigate PEFR in flour mill workers and

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its relationship with age, tobacco smoking, grain dust exposure and its duration and presence of respiratory morbidity.

METHODS

The present study was designed as a cross-sectional study with a comparison group. For the selection of study subjects, Nagpur city was divided in five zones, out of which South zone was randomly selected. The list of all the workers i.e. 320, working in flour mills of the South zone was prepared for the purpose of the study. However, 34 workers could not participate in the study for various reasons. Thus, study finally included 286 flour mill workers. All the study subjects were males. The study subjects were group matched for age with the neighbourhood controls. The exclusion criteria for the controls included exposure to any kind of dusty environment by virtue of their occupation. The interview technique was used as a tool of data collection which included details regarding age, smoking habits, duration of grain dust exposure and presence or absence of respiratory symptoms or signs. The standard diagnostic criteria were used for the diagnosis of respiratory morbidities (7). The PEFR was measured with the help of Wright's Peak Flow Meter and the best of the three readings was noted. The classification of PEFR into reduced or normal PEFR was based on the calculation of predicted PEFR by the formula-663.4-3.37 (age in years) + 7.86 (height in cms) ± as 84 as described by Dikshit and Jog (8). Statistical analysis included tests of significance for means i.e. t-test, z-test and analysis of variance (ANOVA). Univariate analysis was carried out considering PEFR (outcome variable) as a continuous variable. To study the association between reduced PEFR and age, tobacco smoking, exposure to grain dust, duration of exposure and respiratory morbidity, Unconditional Multiple Logistic Regression Analysis (9) was performed by using "MULTLR" statistical software package. Logistic regression analysis is recommended for use in the study of complex etiological processes, where many variables may influence the disease risk. For these multivariable situations, it may be desirable to estimate independent and joint effects with a mathematical model. In the logistic model, the conditional probability of disease (D) occurrence given exposure (E) is represented by a linear function:

$$\text{logit } P\ (D|E) = \ln \frac{[P(D|E)]}{[1-P(D|E)]} = a + bE$$

where logit is an abbreviation of logarithmic unit, in the natural logarithm, $P(D|E)$ = probability of disease given exposure; a, β = regression coefficients; and E is dichotomized as: (0=no exposure, 1=exposure). This simple model may be extended to take into account for potential confounders and effect modifiers (9). The multivariate analysis was carried out by converting best PEFR estimates into discrete variable by dichotomizing into reduced/normal PEFR.

RESULTS

All the 286 subjects in each group were males. Table I shows age wise distribution of PEFR among flour mill workers and comparison group subjects. Two way ANOVA revealed that there is a significant difference in mean observed PEFR of flour

TABLE I : PEFR (L/min) according to age groups among study subjects.

Age groups (in years)	*n*	*Flour mill wokrers*		*Comparison group*		*Test results*
		*MOP**	*SD**	*MOP*	*SD*	
< 20	83	481.21	34.1	583.17	34.7	z=19.1, df=1, P<0.05
21–30	110	463.11	30.2	551.08	28.2	z=22.3, df=1, P<0.01
31–40	74	441.73	29.0	518.22	29.8	z=15.8, df=1, P<0.05
41–50	13	400.57	29.7	499.37	30.3	t=8.4, df=24, P<0.05
> 50	6	356.69	24.3	470.33	22.6	t=8.4, df=10, P<0.05
Mean	286	457.75	26.4	547.84	23.9	z=42.8, df=1, P<0.001

MOP*– mean of maximum observed PEFR;
SD*– standard deviation

mill workers and comparison group while controlling for age (P<0.05). Similarly, mean observed PEFR differs significantly among different age groups while controlling for exposure to dust (P<0.05). Also, significant interaction was observed between age and exposure with relation to observed PEFR (P<0.05). Independent "t" and "z" test revealed that the mean observed PEFR was significantly reduced among flour mill workers as compared to comparison group for all the age groups.

Mean duration of exposure was 7.4 ± 2.1 years with majority of the flour mill workers being employed in the flour mill in the recent past i.e., less than 5 years back. Table II shows mean observed PEFR (L/min.) according to duration of exposure among flour mill workers. From Table II, it can be observed that PEFR values decrease with the increasing exposure and the difference is statistically significant, when the subjects having exposure for more than 10 years were compared with those having exposure for less than 10 years.

Table III shows PEFR (L/min) in relation to smoking habit among study subjects. In flour mill workers, smokers were having

TABLE II : PEFR (L/min) according to duration of exposure among flour mill workers.

Duration of exposure (in years)	*n*	*PEFR*		*Test results*
		Mean	*SD*	
<5	174	465.26	33.1	Z=0.73, df=1, P>0.05
5–10	69	461.72	34.2	t=3.36, df=96, P<0.05
10–15	29	438.03	30.7	t=5.05, df=41, P<0.05
>15	14	385.80	32.3	

significantly lower PEFR values than ex-smokers (t=3.89, df=70, P<0.05) but the difference in PEFR of ex-smokers and non-smokers was statistically non-significant (t=1.44, df=236, P>0.05). When the PEFR of smokers was compared with the non-smokers then the difference revealed statistically significantly reduced PEFR of smokers than non-smokers (z = 9.14, df=1, P<0.01). In the comparison group, the PEFR of smokers was significantly lower than that of ex-smokers (z=13.19, df=1, P<0.01) and non-smokers (z=4.18, df=1, P<0.05).

Of the total 572 study subjects, 95 (64 among flour mill workers and 31 among comparison group) had various respiratory morbidities while 477 study subjects were normal with no respiratory morbidity. Table IV shows the PEFR values of the study subjects having respiratory morbidities, were significantly lower than that of the subjects having no respiratory morbidity.

Table V described the results of Unconditional Multiple Logistic Regression Analysis. Tobacco smoking, grain dust

TABLE III : PEFR (L/min) in relation to smoking habit among study subjects.

Smoking habit	*Flour mill workers*				*Comparison group*			
	n	*MOP**	*SD**	*Test results*	*n*	*MOP*	*SD*	*Test results*
Smoker	48	437.44	16.7		56	469.20	22.1	
				t=3.89, df=70, P<0.05				Z=13.19, df=1, P<0.01
Ex-smoker**	24	456.17	20.4		35	547.57	30.5	
				t=1.44, df=236, P>0.05				Z=4.18, df=1, P<0.05
Non-smoker	214	462.49	19.3		195	570.48	25.9	

*MOP, mean of maximum observed PEFR; SD, Standard deviation.
**Who left smoking for last one year or more.

TABLE IV : PEFR (L/min) according to various respiratory morbid conditions among study subjects.

Respiratory morbid conditions	*n*	*PEFR*		*Mean ± 2SE*
		Mean	*2SE**	
Chronic bronchitis	43	427.17'	5.33	421.84 – 432.50
Bronchial asthma	27	432.44'	11.08	421.36 – 443.52
Active pulmonary TB	03	480.15'	32.11	448.04 – 512.26
Old healed pulmonary TB with symptoms	11	499.33	17.25	482.08 – 516.58
Other COPD	11	436.18'	16.98	419.20 – 453.16
Subjects with no respiratory morbidity	477	515.36	2.03	513.33 – 517.39

*SE = Standard error.
'When compared with those having no respiratory morbid condition, the difference was statistically significant (P<0.05).

TABLE V : Results of unconditional Multiple Logistic Regression Analysis.

Risk factors	*Odds ratio*	*95% CI*	*P value*
	Full Model		
Age	0.78	0.60–1.26	>0.05
Graindust exposure	1.96	1.60–2.21	<0.05
Duration of exposure	1.34	1.01–1.70	<0.05
Smoking	2.11	1.69–2.26	<0.05
Respiratory morbidity	1.78	1.50–2.19	<0.05
	Final Model		
Grain dust exposure	2.04	1.66–2.30	<0.05
Duration of exposure	1.48	1.04–1.57	<0.05
Smoking	2.06	1.56–2.12	<0.05
Respiratory morbidity	1.98	1.51–2.13	<0.05

exposure, duration of exposure and respiratory morbidity were identified to be significantly associated with reduction in PEFR in the full model of Unconditional Multiple Logistic Regression Analysis. The significance of these factors was endorsed by the results of the final model.

DISCUSSION

With increasing age, the PEFR decreases (9). This may be due to the decrease in chest muscle contraction with the advancement of age. However, this decrease was not significant in both the study groups individually in the current study. This may be because of the fact that very few study subjects were in the age group more than 40 years and physiological decline in PEFR is more significant after this age. However, the mean PEFR of comparison group subjects was significantly more than that of flour mill workers for each age group. This can be attributed to the grain dust exposure at work place for the group of flour mill workers. Earlier studies also emphasised the role of grain dust exposure in reduction of PEFR among flour mill workers (1–5).

The lower values of PEFR among flour mill workers exposed to grain dust for longer duration and among smokers in both groups suggest that dust exposure and smoking has effect on PEFR. This is probably due to hypertrophy of mucosal cells due to irritation by grain dust and smoke resulting in the increased secretion of mucus and formation of mucosal plugs which causes obstruction to the exhaled air (10).

This study also identified significant decline in PEFR among study subjects with respiratory morbidity except for old healed pulmonary tuberculosis with symptoms. This may be because of least affection of airways as the tuberculous lesion heal by fibrosis mechanism. The relationship of decline of PEFR and other respiratory conditions was also earlier reported by Florey and Leeder (11).

Except age, four other factors i.e. grain dust exposure, duration of exposure, tobacco smoking and presence of respiratory morbidity were significantly associated with reduction in PEFR in the final model of Unconditional Multiple Logistic Regression Analysis. Role of these factors in reducing PEFR is well known and reported in the literature (4, 5, 10, 11).

The findings of this study recognised role of grain dust for a longer duration in decline of PEFR among flour mill workers. Moreover, the nature of this industry is "unorganised" and scattered all over the country sporadically. Hence, no comprehensive occupational health package is available for the health care and welfare of these workers. Additionally very few studies have been conducted in India among this group of workers to assess lung function and respiratory morbidity. Thus, there is a need to undertake more elaborate research in this group of workers.

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