

The workers in quarry are exposed to silica dust. There are many studies of lung function in quarry workers in Western countries (2, 3, 4) from Singapore (5, 6) and North India (7, 10) but there are no reports from South India. Hence the present study was undertaken in South India quarry workers of Pallavaram Thirusoolam, Chennai.

METHODS

The Medspiror, which is a computerised spirometer that prints out the data, was used to record maximal expiratory flow volume curves. The following lung function parameters were obtained.

1. Forced Vital Capacity (FVC) in ml.
2. Forced Expiratory Volumes (FEV) in ml. in 0.5 and 1.0 seconds ($FEV_{.5}$, FEV_1)
3. Forced Expiratory Volumes percent (FEV %) $FEV_{.5}$ % FEV_1 %
4. Flow rates is in Lit/Sec, listed below
 - (i) Peak Expiratory Flow Rate (PEF)
 - (ii) Maximal Flow rates at 25, 50 and 75% of FVC (FEF_{25} , FEF_{50} , FEF_{75})
 - (iii) Mean Forced Expiratory Flow Rates between 0.2 to 1.2 Litres of FVC ($FEF_{.2-1.2}$) and over the middle half of FVC (FEF_{25-75}).

The subjects were (i) male volunteers from among the quarry workers at

Thirusoolam, Pallavaram and (ii) those in the vicinity not engaged in Quarry work such as Lorry Drivers, Cleaners, shop vendors and office peons. Relevant medical history and smoking habits were elicited from each subject and noted in a proforma. A routine clinical examination was conducted on each subject. Only those with no respiratory disorder and no symptoms of cough, expectoration or wheezing were accepted. Satisfactory data were obtained in 25 quarry workers & from among the other volunteers who were not quarry workers, 20 male subjects were of approximately similar age, height and weight. The subjects were thus made up of the following two groups.

Group (Q) were 25 quarry workers (age 16-40 years)

Group (C) were 20 subjects who were not quarry workers and formed the control group (age 10-39 years)

The quarry workers worked from 8-12 hour a day. The duration of working years of these workers varied from 2-18 years. Four had worked for less than 5 and 9 years, five between 10-14 years and seven between 16 and 18 years. These are for convenience grouped as I to IV. Out of the 25 quarry workers 18 were heavy smokers, smoking between 10 and 30 beedies a day (a few also smoking cigarettes). Among the controls only six were smokers; they were light smokers, smoking generally between 5 and 10 beedies per day, remaining 14 were non smokers.

- (i) In each subject height in cms, weight in kg were taken. The BSA in M^2 was calculated from a nomogram based on the Dubois formula.
- (ii) The test procedure was explained to the subjects and a demonstration of the manœuvre was given. After preliminary trials, the test was performed three times and the highest reading accepted. The tests were done with the subjects in the standing position. The instrument gives the values at BTPS.
- (iii) The data was statistically analysed and tabulated.

RESULTS

The mean values with the standard Deviations (SD) obtained in 25 quarry

workers (Q) and 20 Control Subjects (C) with the mean difference and its statistical significance are shown in Tables I to III. Data for age, height, weight and BSA are shown in Table I. Table II shows the value for Forced Vital Capacity and Forced expiratory volumes. The data for various flow rates are given in Table III. The mean values of some important parameters in the quarry workers grouped according to the duration of their work are shown in Table IV.

As the age, height, weight and BSA of control subjects are approximately similar to quarry workers and the small difference are statistically not significant, a valid comparison can be made of the functional data as these will not be affected by differences in physical measurements between the groups.

TABLE I: Physical measurements, differences of mean values and statistical significance.

		Mean	SD	Mean difference (C - Q)	Significance
Age (yrs)	Q	27.56	(5.08)	1.96	NS
	C	25.6	(5.5)		
Height (cms)	Q	161.60	(5.55)	2.25	NS
	C	163.85	(6.67)		
Weight (kg)	Q	50.24	(6.59)	3.76	NS
	C	54.00	(8.60)		
BSA M^2	Q	1.51	(0.10)	0.06	NS
	C	1.57	(0.13)		

Q - Quarry Workers (25 subjects)

C - Controls (25 subjects)

NS - Statistically not significant

TABLE II: Forced vital capacity (FVC) and forced expiratory volumes (FEV).

		Mean	SD	Mean difference (C - Q)	Significance
FVC (L)	Q	2.51	(0.42)	0.25	NS
	C	2.76	(0.52)		
FEV _{0.5} (L)	Q	1.13	(0.30)	0.38	P<.005
	C	1.51	(0.35)		
FEV ₁ (L)	Q	1.96	(0.42)	0.44	P<.005
	C	2.40	(0.51)		
FEV _{.5%}	Q	44.8	(14.91)	10.00	P<.05
	C	54.8	(13.46)		
FEV _{1%}	Q	77.9	(16.35)	8.9	P<.05
	C	86.8	(11.55)		

TABLE III: Flow rates in L/sec.

		Mean	SD	Mean difference (C - Q)	Significance
PEF	Q	6.42	(1.20)	0.43	NS
	C	6.85	(1.52)		
FEF ₂₅	Q	2.70	(1.01)	0.72	P<.05
	C	3.42	(1.15)		
FEF ₅₀	Q	2.34	(0.71)	0.54	P<.05
	C	2.88	(0.88)		
FEF ₇₅	Q	1.59	(0.55)	0.37	P<.05
	C	1.96	(0.60)		
FEF _{2-1.2}	Q	2.56	(0.96)	0.69	P<.05
	C	3.25	(1.03)		
FEV ₂₅₋₇₅	Q	2.18	(0.61)	0.51	P<.05
	C	2.69	(0.76)		

TABLE IV: Mean values in four groups of quarry workers.

Group	I	II	III	IV
Duration of exposure (years)	< 5	5 to < 10	10 to < 15	15 >
No. of subjects	4	9	5	7
Age (years)	22.2	25.0	29.8	33.0
FVC (L)	2.8	2.5	2.52	2.45
FEV ₁ (L)	2.36	2.07	2.18	1.89
FEV _{1%}	84.4	82.9	86.3	72.2
PEF (L/sec)	7.0	6.5	6.3	6.0
FEF ₂₅ (L/sec)	2.79	2.88	2.68	2.44
FEF ₅₀ (L/sec)	2.50	2.46	2.35	2.00
FEF ₇₅ (L/sec)	2.42	1.68	1.48	1.01

All the functional parameters are lower in quarry workers than in control subjects, but the difference in FVC and PEF are statistically not significant. For other flow rates the differences are significant at 5% level. The Forced Expiratory Volumes at half and one second are highly significant (at 0.5% level). The $FEV_{.5}$, FEV_{1} are also significant but only at 5% level.

There is a wide variability of mean values reported by various investigators both Indian and Western. A comparison with other Indian data shows that FVC in the present control subjects are much lower than the values from Madras obtained by Singh & Prabhakaran (11), Kamat et al (12), but these data are from subjects of a better socio-economic status than the controls in this study. They are closer to the values obtained in pottery workers of Vellore by Milledge (13) and Transport workers of Madras by Jayalakshmi (14).

The $FEV_{.5}$ values noted in this study are lower than those reported by Miller et al (15) and Singh et al (16), but they are seldom used to assess lung function, due to wide variability of normal values, and there are very few reports for comparison.

The peak flow rates are lower than the values reported by Kamat et al (12) & Singh & Peri (17) but closer to the values found by Kailash (18) and Jayalakshmi (14). All other flow rates are lower than other South Indian values. All the flow rates except FEF_{75} are lower than those observed in South Indians (19, 20). All the mean functional values in quarry workers are lower than those of healthy subjects of the control group. The difference in mean FVC

and PEF are however not significant, while those of the other parameters are significant.

When examined according to duration of exposure it is found that the highest mean values were obtained in Group I for all parameters except FEV_{1} and FEF_{25} which were somewhat (but not significantly) higher in Group III and II respectively. All the values were lowest in Group IV, especially in FEF_{75} which showed the largest reduction. The differences may be either due to exposure to silica dust or to smoking habits as most of the quarry workers are smokers while most of the controls are non smokers.

DISCUSSION

Using MEFV curves Chia et al (5) found evidence of small airway obstruction in Singapore quarry workers, which was greater in smokers and higher dust exposure subjects. Lemle et al (4) found the reduction in FVC, FEV_{1} and FEF_{25-75} occurred only in quarry workers with symptoms of cough with expectoration and not in symptom-free subjects. They considered that the effects were due to chest diseases and smoking and not due to dust exposure. They also noted that duration of dust exposure as such had not much effect, but lung functions were worse in smokers. Begatin et al (2) also found that lung function was worse in smoking quarry workers.

In Indian quarry workers Gupta et al (7) found FVC, FEV_{1} and $FEV_{1\%}$ within normal limits in subjects with normal chest X-ray and were significantly decreased in Grade III & IV silicosis. Mathur et al (8)

using only PEF found a reduction in PEF was significantly correlated with radiographic opacities and smoking habits but not with duration of exposure. Gupta et al (10) found that workers of older age and greater duration of employment had significantly lower values of FVC₁, FEV₁ and PEF than younger workers with shorter duration of work, a finding which is in agreement with the observations in this study.

A meeting of experts on respiratory function tests in Pneumoconiosis of International Labour Organisations (21) in 1996 concluded that lung functions may be normal in minimal nodular sclerosis, but only in more advanced and disseminated forms there are both obstructive and restrictive type of defects with reduction in FVC and FEV_{1%}.

Since numerous studies have established that lung function reduction is not so much related to duration of dust exposure but is

largely due to presence of chest diseases revealed by cough, expectoration etc., and to smoking habits and since the quarry workers in this study are free from respiratory diseases but are heavy smokers compared to control subjects it appears that any reduction in lung function is due to smoking habits and not due to dust exposure. The very low FEF₇₅ in Group IV quarry workers suggests a possible small airway involvement. This group has the longest smoking history.

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