$FEF_{200-1200}$, $FEF_{25-75\%}$ AND $FEF_{75-85\%}$ IN NON-SMOKERS OF EITHER SEX AND IN MALE SMOKERS RESIDING AT AN ALTITUDE OF 2150 M ABOVE MSL IN HIMACHAL PRADESH

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Summary : Forced expiratory flow (FEF) rates were determined for 170 (130 males and 40 females) healthy adults of Himachal Pradesh in the age group of 19-26 years for males and 19-22 years for females. The subjects had been staying at an altitude of 2150 M above mean sea level (MSL) for at least three years prior to the conduct of the study. $FEF_{200-1200}$, $FEF_{25-75}\%$ and $FEF_{75-85}\%$ were found to be high as compared to those reported from most other parts of the country. The results were found comparable with those roported from certain populations in U.S.A. Further, the flow rates of the non-smoker males were compared with those of the male smokers. $FEF_{75-85}\%$ in smokers was significantly less than that of non-smokers, whereas the differences in $FEF_{200-1200}$ and $FEF_{25-75}\%$ were found to be nonsignificant.

Key words $FEF_{200-1200}$ $FEF_{25-75}\%$ $FEF_{75-85}\%$
2150 M altitude smokers Himachal
non-smokers

INTRODUCTION

Expiratory flow rates are important indicators for diagnosis, prognosis and for therapeutic evaluation of chronic obstructive lung diseases (7,15,16,18). Forced expiratory flow between 200-1200 *ml* ($FEF_{200-1200}$), between 25-75% ($FEF_{75-85}\%$) and between 75-85% ($FEF_{75-85}\%$) of forced vital capacity (FVC) are three such important dynamic lung function tests which are used to assess the patency of respiratory air-ways. The values for these flow rates are known to decrease not only in chronic obstructive lung diseases (1,15) but also in otherwise-healthy smokers (7,11,14). Relatively more empha-

sis is being recently, laid on $FEF_{25-75}\%$ and $FEF_{75-85}\%$ (13,14,18) as compared to the initial flow patterns like FEV_1 and $FEF_{200-1200}$, since the former two have been reported to be comparatively more effort-independent (13,18).

These expiratory flow rates have been reported from several parts of the country by various workers (2,3,4,6,9,10,14,17). The same have been studied both in non-smokers (males and females) and smokers (males) in Himachal Pradesh in the Western Himalayas through the present work.

MATERIAL AND METHODS

The study was conducted on 170 (130 males and 40 females) subjects who were natives of Himachal Pradesh in the Western Himalayas residing, for at least three years continously prior to the conduct of the study, at Shimla located at an altitude of 2150 M (7054 ft) above mean sea level (MSL) with a corresponding barometric pressure of 585 mm of Hg. The male subjects comprised of 80 healthy non-smokers, or only occasional non-habitual smokers, in the age group of 19-26 years and 50 smokers (who used to smoke 10-20 cigarettes a day for at least three years) in the age group of 22-26 years. The female subjects were in the age group of 19-22 years. All the subjects were screened clinically to exclude any evident cardio-respiratory disorders.

Body height and body weight without shoes and only with light clothings were noted for each subject. The subjects were given adequate rest for at least 20 min in an adjacent room during which each subject was thoroughly explained about the nature of the tests and two practice sessions of recordings were done for each subject. The recordings were made at the same time of the day everyday to avoid the effect of diurnal variation for all the subjects.

The expiratory flow rates were recorded by using a 'Vitalor' spirometer (Air-Shield, Pennsylvania, U.S.A.). The subjects were made to sit comfortably on the chair while performing the tests. Three records were taken for each subject, with adequate rest in between, and the mean of these three records was taken for calculation. $FEF_{200-1200}$, $FEF_{25-75}\%$ and $FEF_{75-85}\%$ were calculated from the FVC graph. All the volumes were converted to body temperature, pressure and saturation (BTPS) and were expressed as rates in Litres/min. Room temperature ranged from 24.5-26.0C° throughout the course of the study.

RESULTS

Values for $FEF_{200-1200}$, $FEF_{25-75}\%$ and $FEF_{75-85}\%$ in non-smoker males and females as well as in male smokers have been shown in Table I, which also shows the

statistical significance. The present study has been compared, age and sex matched, with similar works reported from various geographical regions of India and with certain reports from a section of population in U.S.A. (Table II).

TABLE I : Various forced expiratory flow rates (mean ± SEM) in male and female non-smoker subjects and in male smokers.

Group	$FEF_{200-1200}$ *(L/min)*	$FEF_{25-75\%}$ *(L/min)*	$FEF_{75-85\%}$ *(L/min)*
I. Non-smokers			
Male (n = 80)	433.2 ± 28.02	284.7 ± 7.82	134.9 ± 6.47
Female (n = 40)	347.8 ± 13.40	221.1 ± 8.19	102.6 ± 3.57
Statistical significance of male *vs* female	P < 0.01	P < 0.001	P < 0.001
II. Smokers			
Male (n = 50)	425.9 ± 32.21	269.6 ± 11.13	111.7 ± 9.30
Statistical significance of non-smoker males *vs* male smokers	N.S.	N.S.	P < 0.05

N.S. = Non - significant

TABLE II : Age and sex matched comparison of the forced expiratory flow rates in Himachal Pradesh with those reported from other parts. All the values reported are from non-smokers only.

Geographical region	*Age groups (yrs)*		$FEF_{200-1200}$ *(L/min)*		$FEF_{25-75\%}$ *(L/min)*		$FEF_{75-85\%}$ *(L/min)*		*Reported by*
	male	*female*	*male*	*female*	*male*	*female*	*male*	*female*	
Delhi	19-22	—	313	—	220	—	—	—	Jain and Ramiah (4)
	23-26	—	316	—	225	—	—	—	
Gujarat	18-20	—	218	—	79	—	—	—	Mazumdar *et al.* (9)
Rajasthan	17-27	17-27	—	—	188.48	138.72	—	—	Gupta *et al.* (3)
Haryana	18-22	—	—	—	275	—	—	—	Mahajan *et al* (6)
Madras	18-24	—	—	—	—	—	92.88	—	Singh and Krishna murthi (17)
Tirupati	20-22	17-19	194	120.5	—	—	—	—	Meti (10)
	23-25	20-22	191	162.5	—	—	—	—	
Jammu(J&K)	*30(mean)		—	—	233.4	—	76.8	—	Sadhoo *et al.* (14)
Madhya Pradesh	16-25	16-25	—	—	290	286	—	—	Bhargava *et al.* (2)
Uttar Pradesh	16-20	16-20	314	208	192	169	—	—	Mathur *et al.* (8)
	21-25	21-25	317	226	224	201	—	—	
WESTERN									
U.S.A.	20-29	20-29	513.6	344.4	292.2	225.6	—	—	Morris *et al.* (12)
U.S.A.	*30-49	*30-49	—	—	246	186	73.8	60.6	Morris *et al.* (11)
Himachal Pradesh (2150 M above MSL)	19-26	19-22	433.2	347.8	284.7	221.1	134.9	102.6	Present study

*= not age-matched
All the geographical regions (including U.S.A.)mentioned in the Table are low altitude regions (less than 250 M above MSL)

DISCUSSION

Forced expiratory flow between 200-1200 *ml* of FVC, also known as maximal expiratory flow rate (MEFR) (9), has been reported from different parts of India (Table II). The values for the adult Himachali male and female (Table I) can be seen to be the highest as compared to those reported from any other part of the country (4.8,9,10). Forced expiratory flow between 25-75% of FVC, also known as maximal midexpiratory flow rate (MMEFR) (5,14), has been more often reported from various parts of India. The value of $FEF_{25-75}\%$ in Himachali males is comprable with that obtained in the males of Madhya Pradesh (2), while the same in Himachali females is considerably less than that reported for the females of Madhya Pradesh (2). The reports from other parts of the country (3,4,6,8,9,10) show lower values of $FEF_{25-75}\%$ in both males and females as compared to those in the present study. Forced expiratory flow between 75-85% of FVC, also known as forced endexpiratory flow rate (FEEFR) (14), has been the least reported from India in contrast to the other flow rates. This flow rate is more in Himachali males as compared to those reported from Jammu (14) and from Madras (17).

$FEF_{200-1200}$ in females and $FEF_{25-75}\%$ both in males and females obtained in the present study are comparable with those obtained from a section of population in U.S.A. (12) of comparable age group, whereas $FEF_{200-1200}$ in males in the present study shows a censiderably lower value. On the other hand, the somewhat lower values of $FEF_{25-75}\%$ and $FEF_{75-85}\%$, both in males and females, reported from a section of population in the U.S.A. by Morris *et al.* (11) may be due to the higher age group of their subjects as compared to that in the present study. Again, the difference in $FEF_{25-75}\%$ in records obtained by these U.S.A. workers during the two different periods (in year 1971 and in 1975), as shown in Table II, is possibly due to the difference in the age group of their subjects in the two studies.

These high values of $FEF_{200-1200}$, $FEF_{25-75}\%$ and $FEF_{75-85}\%$ are in agreement with our own experiences (sent for publication) which suggests high values of FVC, $FEV_1\%$ and PEFR in the natives of this part of the country in the Western Himalayas. However more works at varying altitudes need to be conducted to ascertain whether these high values of various expiratory flow rates in Himachalis are due to their nativity or due to the effect of altitude to which they are exposed.

When the flow rates of the non-smoker males were compared with those of the male smokers, $FEF_{75-85}\%$ was found to be significantly less in the latter group, whereas $FEF_{200-1200}$ showed practically no difference and $FEF_{25-75}\%$ showed only a slight nonsignificant difference. Several other workers have reported (5,7,11,14) a similar pattern of flow rates in smokers.

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