PULMONARY FUNCTION IN HEALTHY PAKISTANI ADULTS AT DIFFERENT ALTITUDES

Pages with reference to book, From 158 To 163

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Abstract

The pulmonary functions (FVC; FEV1; FEV1 /FVC% and MVV) were measured in healthy Pakistani adults (aged 20 to 40 years) at various altitudes. The subjects were divided into four groups (Group i residing at 500m above sea level; Group-li fresh arrivals at an altitude of 2250m; Group-Ill acclimatised to various altitudes above 3250m and Group-IV highlanders living above 2250m). The effects of age and height on FVC and FEV1 were found to be similar to those in previous studies. There was no significant difference in FVC among group I, II and Ill whilst group IV exhibited higher values. However, FVC values from- Group I, II and IV were slightly lower than the European and the North American population of European descent. Values of FEV1/FVC% of all the groups were found to be a little higher than those reported by other investigators. Multiple regression formulae drawn here for various age and height of all these groups can be reliably applied to assess the pulmonary function for subjects located at these altitudes (JPMA 38 : 158,1988).

INTRODUCTION

Pulmonary function testing has become a routine part of the evaluation of patients in whom a diagnosis of pulmonary abnormality is suspected. Body plethysmography, close volume test and measurement of lung compliance are difficult tests, not suitable for mass testing, as they are time consuming and there are intra-subject and inter-subject variations[1]. Spirometry offers the simplest test available for such evaluation, the recorded result in an individual being compared to an established standard range to determine whether the result falls within or outside such range. Numerous studies have shown that ventilatory lung values are related to sex, age, anthropometric parameters, ethnic origin, smoking habit, occupational exposures, environmental conditions and methods used[2-5]. Many prediction formulae have been developed for various “normal” or specific populations. It is important that a normal range in a given population be defined as accurately as possible so that the data are useful for both experimental and clinical studies. Previous studies have reported that spiro metric values in normal Pakistani adults are lower than those in European adults[4-6].The present study was undertaken to measure the range of spirometric values in a group of people at various altitude using current criteria for spiro-metric measurements and to obtain prediction formulae for lung function tests in that area.

PATIENTS AN METHODS

Subjects:

Four groups were studied. Each group comprised of 15 subjects, all were healthy normal, non-smokers with no systemic disease which could directly or indirectly influence the cardiopulmonary system. None had a history of upper respiratory tract infection during the preceding three weeks.

Group-I: All were residing at Rawalpindi (500 meters above sea level) and were labelled, as sea-level group. All were low landers, none having been exposed to higher altitude for at least two months prior to this study. All subjects were within 20 to 34 years of age (Mean ± SD 26.33 ± 4.92).

Group-II: These subjects arrived at Skardu (2250 meters) within 72 hours of their departure from Rawalpindi. This group was labelled as fresh arrivals at altitude. They were all lowlanders and had not been posted at altitude prior to this study. They were within 20 to 38 years of age (Mean ± SD 26.87 ± 6.01).

Group-III: These lowlander subjects had been on the mountains at various altitudes above 4000 meters for more than a year. They were fully acclimatised to high altitude and Were, therefore, labelled as an acclimatized group. Their age ranged between 22 to 36 years (Mean ± SD 27.93 ± 4.45).

Group-IV: These subjects were born and brought up at altitudes of 2250 meters or above. They were labelled as local highlanders. None of them had descended to low altitude for at least 2 months prior to this study. Their age varied between 17 to 32 years (Mean ± SD 22.93 ±4.65).

Technique:

Spirometric measurements were made by the standard technique. The apparatus consisted of a mouthpiece attached to a flexible tube, the latter connected to spirometer (VICA-TEST Bedienung-Hellige GMBH Germany). The pressure across the mouthpiece proportional to air flow was recorded on a direct pen writing which moved on specially designed VICA-TEST graph paper and the resultant curve was plotted. The ambient temperature and barometric pressure (ATPS) were recorded. Each subject was first instructed to perform a maximum expiratory effort after maximum inhalation (to lung capacity); at least three spirograms which met the standard criteria of acceptability were recorded in all the subjects[7].

Expression of Data:

From these recordings using standard measurement techniqu3s including the use of back extrapolation the values of FVC, FEV1, the ratio of FEY1 to FVC (FEY1 /FYC%) and MW were calculated. Values derived from the spirogram with the highest values for the sum of FYC and FEY1 were converted to BTPS. MYY was calculated by multiplying corrected FEY1 by 30 as mentioned in the spirometer manual. Mean and standard deviation were calculated for each of the parameters in various groups. Multiple regression formulae were constructed for the individual parameter in relation ‘to age and height[7]. Observed values of FYC were compared with the predicted values given in the manual.

RESULTS

A total of 80 subjects were studied (20 in each group). Acceptable data were available in 60 subjects (15 in each group). Anthropometric measurements of each group are shown in Table-I.

Table 1. Anthropometric Measurements of Subjects. (Mean ± SD)

Group	I	II	III	IV
Age (Years)	26.33 ±4.92	26.87 ±6.01	27.93 ±4.45	22.93 ±4.65
Weight (Kg)	63.53 ±6.86	62.13 ±7.08	61.21 ±6.85	60.22 ±6.96
Height (cm)	172.07 ±6.44	169.47 ±5.99	167.67 ±4.36	166.47 ±5.12
B.S.A. (m^2)	1.75 ±0.12	1.72 ±0.11	1.70 ±0.09	1.67 ±0.10

The mean and standard deviation of various parameters of each group are shown in Table-II

Table II. Mean + SD of Different Parameters in various Groups.

Group	FVC (L)	FEV_1 (L)	FEV_1/FVC (%)	MVV (L/min)
I	3.934 ±0.515	3.425 ±0.473	87.0 ±5.4	102.66 ±14.13
II	4.131 ±0.744	3.705 ±0.659	89.6 ±4.2	111.00 ±19.69
III	3.802 ±0.786	3.303 ±0.708	86.4 ±4.5	99.73 ±20.22
IV	4.343 ±0.741	3.749 ±0.736	85.7 ±7.0	112.42 ±20.98

There was no significant linear correlation of weight and body surface area with any measured pulmonary parameters, while age and height had profound effect on spirometric values. The estimated rate of decline increased linearly with age while all the parameters showed a linear increase with height (Figure 1-4).

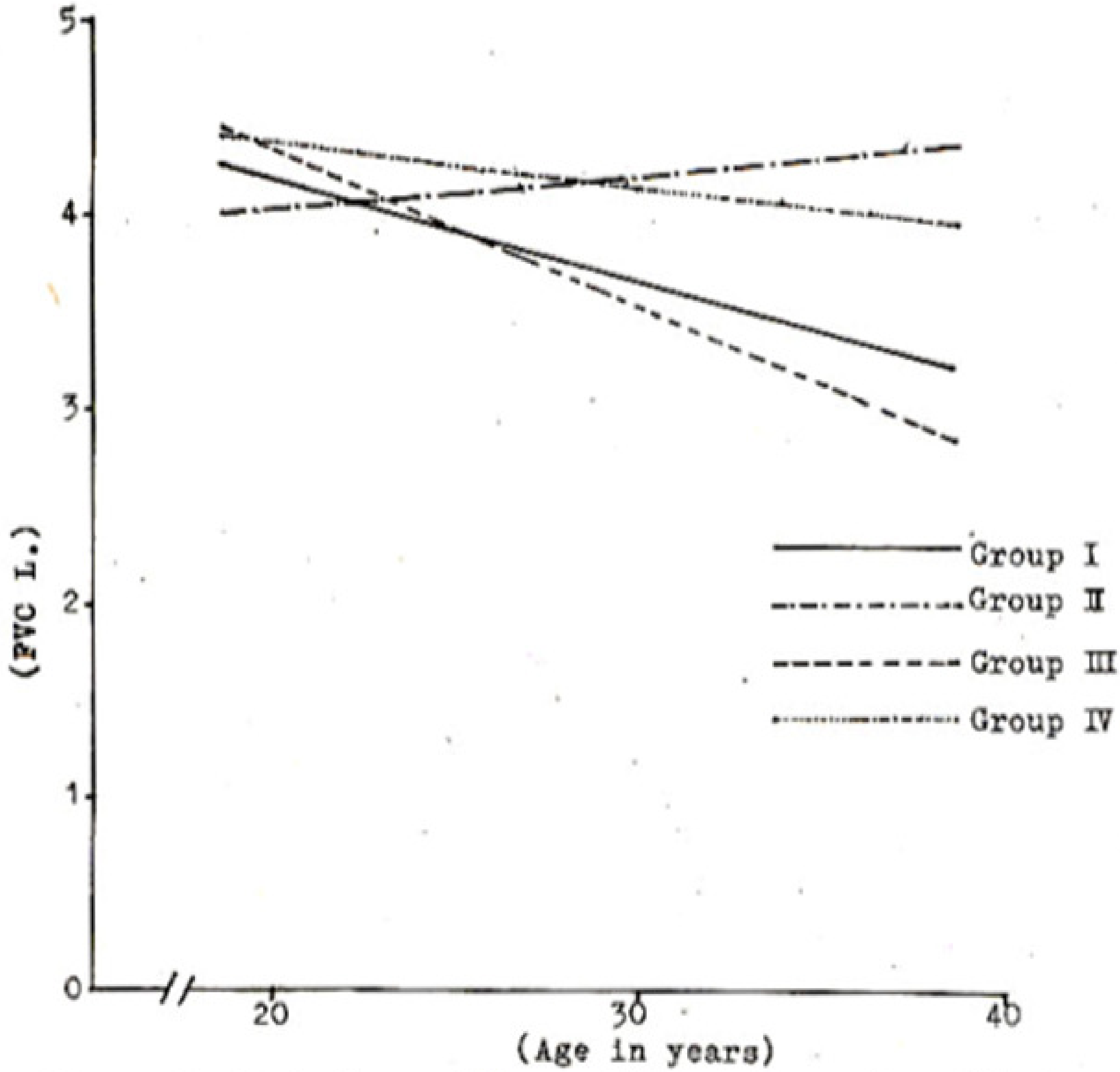

Figure 1. Relation of Forced Vital Capacity with Age in groups.

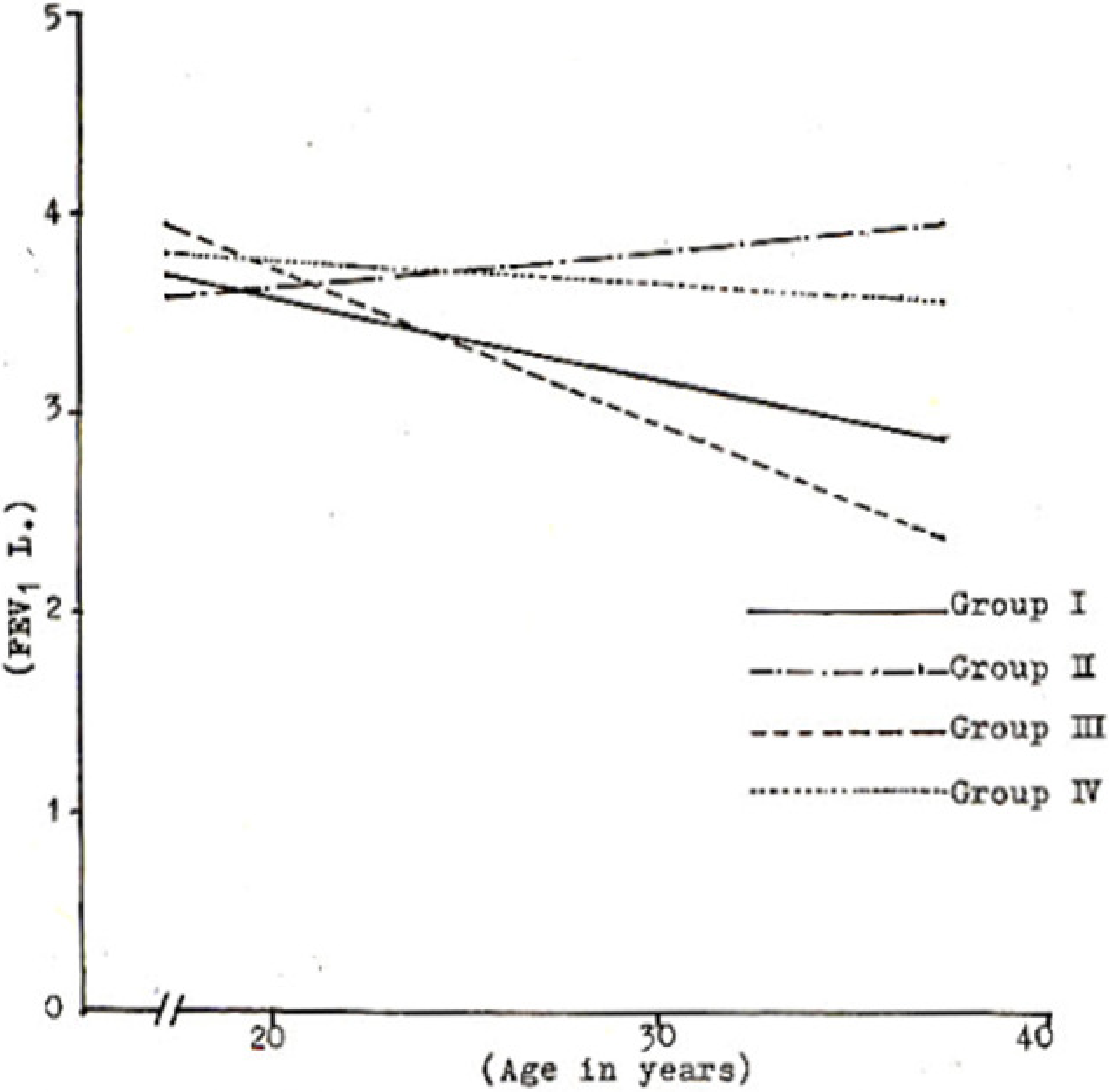

Figure 2. Relation of FEV_1 with Age in groups.

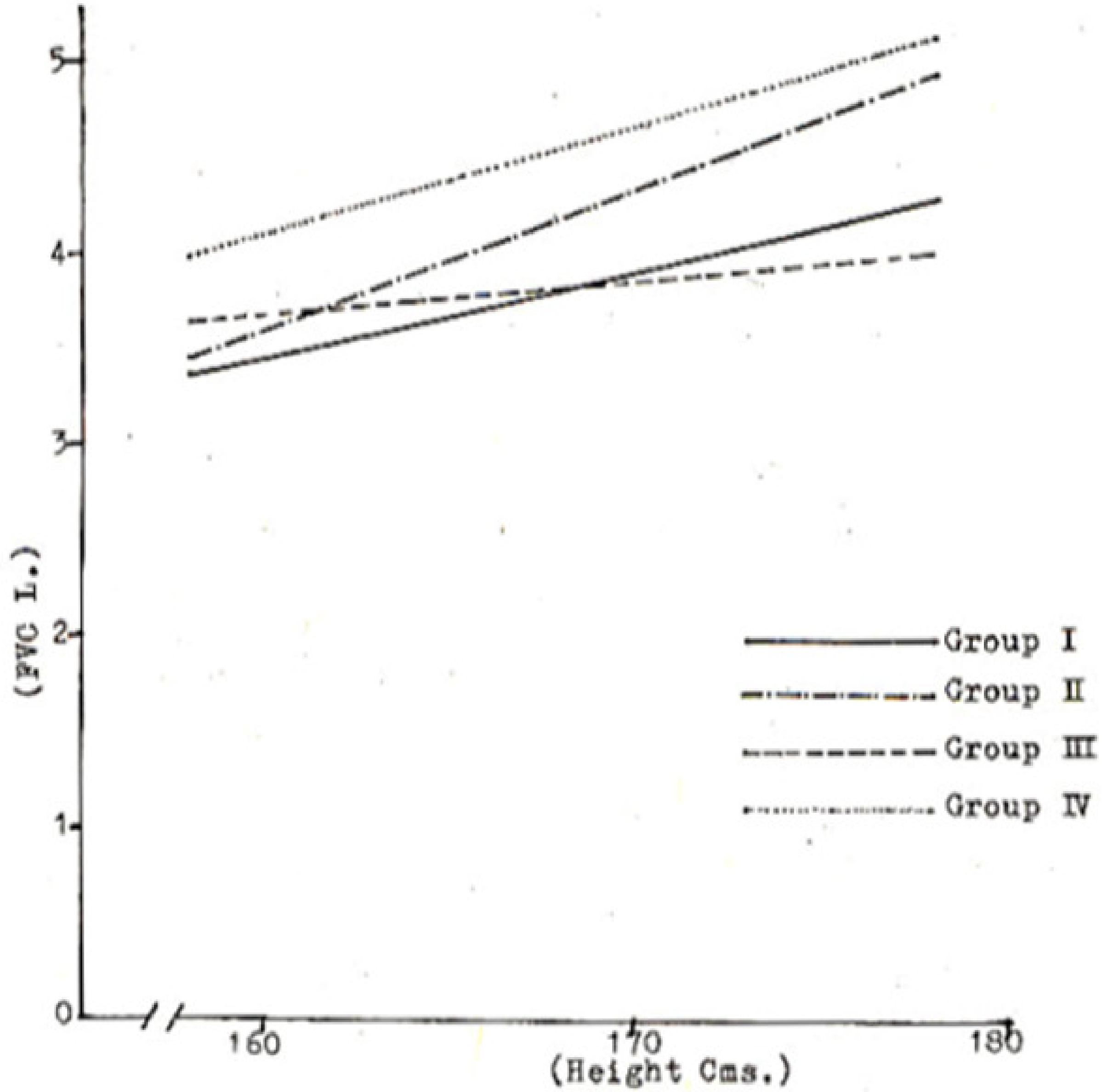

Figure 3. Relation of Forced Vital Capacity with Height in groups.

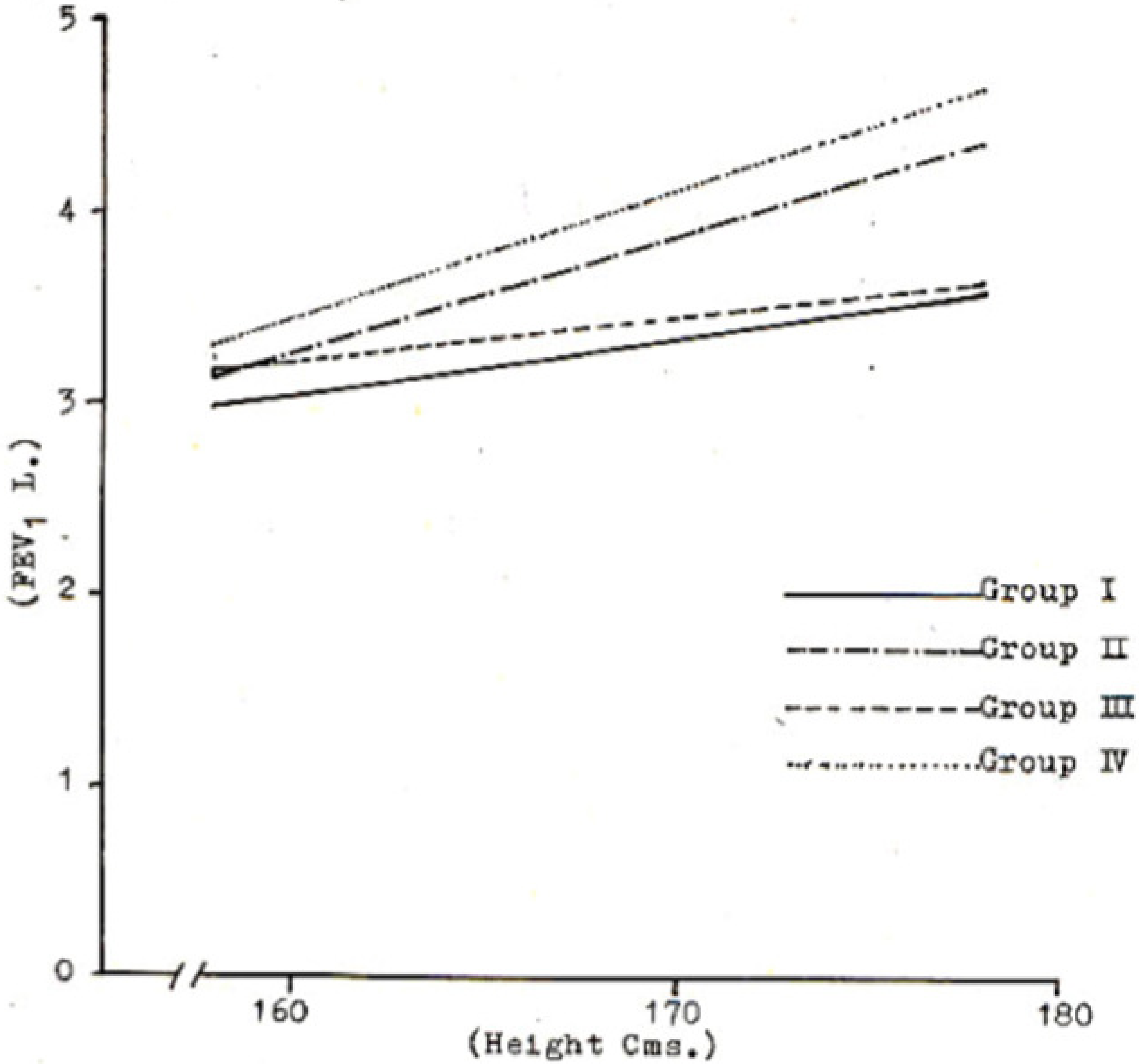

Figure 4. Relation of FEV_1 with Height in groups.

Table III. Multiple Regression Equations.

	Group I	Group II	Group III	Group IV
Parameter	$Y = a+bx + cz$ SEE	$Y= a+bx + cz$ SEE	$Y = a+bx + cz$ SEE	$Y = a + bx + cz$ SEE
FVC	$-0.006+0.002x+0.023z \pm 0.528$ $r= 0.399$ $P<0.01$	$-0.10\text{-}0.0002x+0.024z \pm 0.782$ $r= 0.341$ $P<0.05$	$0.00008+0.002x+0.22z \pm 0.854$ $r= 0.109$ N.S	$-0.005+0.001x+0.026z \pm 0.798$ $r= 0.268$ $P<0.1$
FEV_1	$-0.003+0.001x+0.020z \pm 0.500$ $r= 0.327$ $P<0.05$	$-0.008-0.0003x+0.022z \pm 0.694$ $r= 0.333$ $P<0.05$	$-0.0004+0.002x+0.019z \pm 0.787$ $r= 0.110$ N.S	$-0.015\text{-}0.0002x+0.02z \pm 1.704$ $r= 0.258$ $P<0.1$
FEV_1/FVC	$0.191\text{-}0.022x+0.508z \pm 6.648$ $r= 0.459$ $P<0.01$	$0.155+0.004x\text{-}0.527z \pm 5.187$ $r= 0.464$ $P<0.01$	$0.40+0.004x+0.514z \pm 4.859$ $r= 0.281$ $P<0.1$	$0.001\text{-}0.007x+0.515z \pm 7.374$ $r= 0.346$ $P<0.05$
MVV	$-0.073+0.036x+0.592z \pm 14.940$ $r= 0.325$ $P<0.05$	$-0.249\text{-}0.009x+0.658z \pm 20.77$ $r= 0.333$ $P<0.05$	$-0.014+0.56x+0.586z \pm 22.428$ $r= 0.124$ $P<0.05$	$-0.217+0.031x0.672z \pm 23.631$ $r= 0.275$ $P<0.1$

x = Age ; z = Height

SEE = Standard Error of Estimate ; r = Coeff. of Correlation

Table III represents multiple correlation with the age, height and various respiratory parameters (FVC; FEY1 /FVC% and MVV) in various groups. However, no significant correlation was seen in groups III and IV. The comparison of observed FVC of each group with the predicted values drawn from the nomogram for specific age, weight and body surface area is shown in Figure 5,

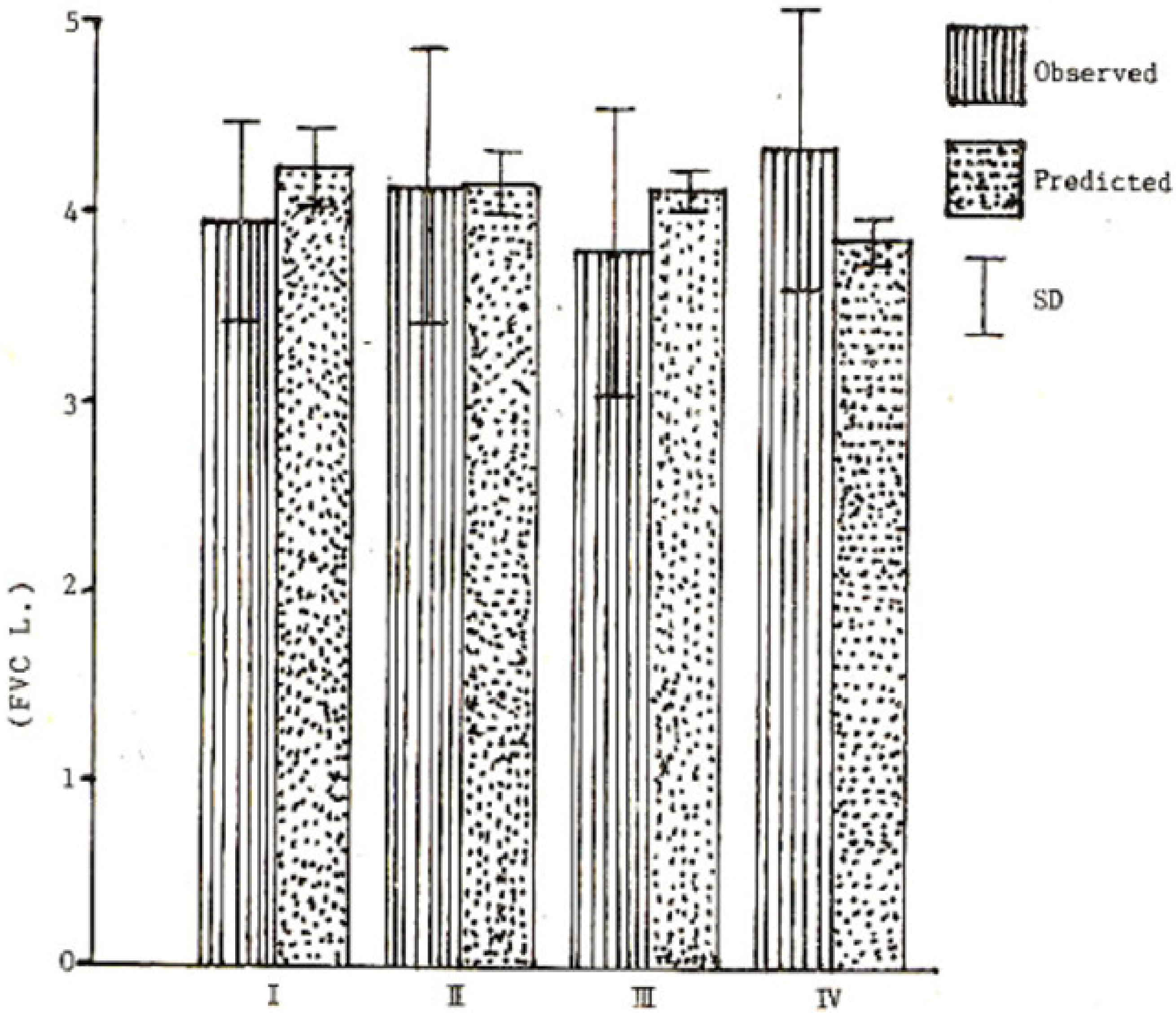

Figure 5. Relation of Observed and Predicted FVC in groups.

whereas,

Table IV. Comparison of predicted Spirometric values from various Studies.

Study	Predicted Values for height 1.67m and Age 25 Yrs	
	FVC	FEV_1
Present	3.89	3.36
Ayub et al. (16)	3.97	3.36
Williams et al. (4)	4.19	3.69
Malik et al. (6)	4.19	3.69
Jain & Ramiah	4.02	3.66
Lam et al. (5)	4.42	3.38
Cherniack & Raber	4.42	3.91
Bass (15)	4.04	--
Knudson et al. (10)	4.67	3.81
Crapo et al. (14)	4.84	4.11

All volumes in Litres, BTPS.

Table-IV represents the comparfron of predicted spiro-metric values with the observations reported by other authors.

DISCUSSION

In this study, we developed reference Standards for pulmonary parameters in a group of subjects exposed to different environmental conditions and stationed at different altitudes. We preferred to study healthy young subjects in order to develop a set of standards against which the pulmonary functions of the subjects likely to be posted to these areas could be compared. Highlanders are known to be some what smaller in height and weight with bigger chest and have less obesity than low landers.[8,9,12]. The data of our group IV subjects are in conformity with those of the previous studies. Figures 1 and 2 illustrate the profound effect of ageing on FVC and FEy1. Our findings of steady decrement in FVC and FEy1 with age was similar to the Euro pean population.[4,6] However, in our finding Group-II subjects showed slight increase in FVC and FEY1 with age. Schoenberg and cowor kers3 have suggested that FVC in adults increases as weight increases "muscularity effect" and then decreases as weight continues to increase, "obesity effect". Weight is considered as a risk variable. Knudson an have suggested that the median of height adjusted FVC and FEy1 for men may have a maximum around 30 years of age. They also indicate that FVC increases slightly between 25 and 34 years of age. FEV/FVC % seems to be maximum at the age of 30 or possibly later. Our subjects in group-II were in the same age group as mentioned by Knudson and coworkers[10] and they did not have altitude effect either that could cause weight loss and reduce muscle power. This may be one of the causes of having higher FVC compared to other groups. However we cannot make a definitive interpretation of this observation as we did not have a longitudinal study and the number of subjects in our group is too small. Pulmonary function parameters can be better predicted from height than from age. In adults height almost always has a positive linear relationship. Our findings of effect of height on pulmonary values in all groups have similar relationship. Highlanders, because of their small height and broad chest always have higher lung volumes. In fact it has been mentioned that FVC increased by 100 C.C for every 300 m increase in altitude residence[3]. The increase in FVC than the predicted values in our group IV subjects also confirms this finding (Figure 5). The group III subjects had less FVC than the predicted values. This possibly is due to the weight loss of the low-lander (mainly due to anorexia) on transfer to high altitude.[12,13]. These subjects though acclimatised to high altitude continue having loss of weight and consume body fat which in turn reduces their muscle power and thus they tend to have lower lung volumes. A number of studies in European and North American population of European[10,14,15] descent indicate that the Pakistani subject in younger age group have lower FVC and FEV1. There are few studies of the normal range of pulmonary function in Pakistani adults. To compare our data, we have included the predicted values from the previous studies for height 1 .67m and age 25 years. Our findings are comparable to those of Ayub et al.[16] but are less than the European. In conclusion, the present study of spirometric lung volumes among different groups of subjects at various altitudes and environmental conditions confirm that age has decremental effect while height has positive linear relationship with lung volumes. These values are smaller than in populations of European descent. These data indicate that, for clinical purposes, in Pakistani men, the use of predicted values derived from European male population cannot be truely appllcable. People residing at high altitude and those acclimatized to high altitude will always have different values. We have drawn multiple regression formulae for all the groups which could be rellably applled to Pakistani adults exposed to these conditions and located at these altitudes.

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