PEAK EXPIRATORY FLOW RATE IN NORMAL ADULT CHINESE IN SINGAPORE

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SYNOPSIS

There is need for a simple and reliable instrument to assess impairment of ventilatory function. The Wright peak flow meter which measures the peak expiratory flow rate (PEFR) fulfils this need and has proved useful at the bedside, in the busy general practitioner's office, in the laboratory as well as in field studies.

Formulae for prediction of normal values of PEFR in both male and female adult Chinese have been derived from a study of 212 normal subjects and a nomogram has been constructed for rapid calculation.

Estimation of the peak expiratory flow rate (PEFR) using the Wright peak flow meter (Wright and McKerrow, 1959) is a rapid and reliable test of ventilatory function. As the instrument is inexpensive, portable and easy to operate the observation of the PEFR is practical for both hospital and general practice, and as a screening test in epidemiological studies.

The PEFR in normal adults has been extensively studied in the United Kingdom (Lockhart *et al*, 1960; Tinker, 1961; Flint and Kahn, 1962; Shephard, 1962), the United States (Leiner *et al*, 1963) and Scandinavia (Huhti, 1967; Källqvist *et al*, 1970). Only one study of the normal PEFR in adult Chinese (Chiang, 1962) has been reported and this had inadequate representation above the age of thirty-five. The present study was carried out to establish reliable normal values for PEFR in adult Chinese of both sexes by having adequate representation in the different age groups.

MATERIAL AND METHODS

212 'normal' Chinese adults (116 males and 96 females) were studied. The subjects were drawn from hospital staff, medical students, blood donors, preemployment medical examinees and patients attending the Outram Road General Hospital. The subjects were distributed uniformly in five-year age groups from 15 to 70 in males and from 15 to 49 in females. Older subjects were not readily available but there were, however, 6 males older than 70 years and 20 females above the age of 49.

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The following criteria were used for acceptance as a 'normal' subject:

1. no history of cardiopulmonary disease;
2. no evidence of cardiopulmonary disease on a recent chest radiograph;
3. no evidence or history of disease which could influence pulmonary function;
4. capacity to cooperate adequately during the tests.

Height was measured without shoes.

The PEFR was measured with the Wright peak flow meter (restyled standard model M.286, Airmed Ltd., U.K.). Only one meter calibrated in the factory was employed for all the measurements. Each subject had five determinations of PEFR in standing position after being fully conversant with the details of the manoeuvre. The best observation was recorded at ambient temperature and pressure saturated with water vapour (ATPS).

Statistical analysis of the data was carried out using a Hewlett-Packard calculator. Regression equations were derived for predicting PEFR from height and age in each sex and a nomogram was then constructed for easy calculation of predicted normal values.

RESULTS

The mean values of PEFR for the subjects studied are given in the Table.

The regression equations for predicting the PEFR in each sex from height (H, inches) and age (A, years) are given below:

Males, PEFR (l/min) = $9{\cdot}8\,H - 1{\cdot}2\,A - 72{\cdot}1$

Females, PEFR (l/min) = $5\,H - A + 159$

A nomogram was constructed based on these equations (Fig. 1).

TABLE I

MEAN VALUES ± STANDARD DEVIATION (M ± SD) OF PEFR FOR THE SUBJECTS IN THE VARIOUS AGE GROUPS

Age Groups Years	Number Males	Mean Height, Ins.	PEFR, l/min M ± SD	Age Groups Years	Number, Females	Mean Height, Ins.	PEFR, l/min M ± SD
15 - 19	10	66·1	507 ± 44	15 - 19	10	61·2	440 ± 39
20 - 24	10	66·8	581 ± 46	20 - 24	10	60·9	417 ± 36
25 - 29	10	66·1	510 ± 26	25 - 29	10	62·2	450 ± 50
30 - 34	10	65·5	533 ± 50	30 - 34	10	61·5	438 ± 36
35 - 39	10	65·2	557 ± 42	35 - 39	10	62·1	450 ± 54
40 - 44	10	64·7	531 ± 63	40 - 44	10	61·7	434 ± 23
45 - 49	10	65·3	528 ± 37	45 - 49	10	60·5	423 ± 48
50 - 54	10	64·8	519 ± 60	50 - 54	8	57·9	392 ± 52
55 - 59	10	64·5	504 ± 59	55 - 59	7	60·3	404 ± 46
60 - 64	10	64·7	458 ± 21	60+	11	61·2	382 ± 34
65 - 69	10	64·4	464 ± 72				
70+	6	63·7	451 ± 45				
TOTAL	116	65·2	514 ± 59		96	61·0	424 ± 46

PEFR correlated positively with height in both sexes. There was little change in PEFR with increasing up to the age of 39 in both sexes. Thereafter the PEFR gradually declined with increasing age.

DISCUSSION

The results in this study are slightly higher than those of Chiang (1962) in the Taiwanese, and lower than those reported by Tinker (1961) in the British and Huhti (1967) in the Finns. However, other studies have reported similar results in both British (Shephard, 1962) and Swedish males (Källqvist *et al*, 1970). It is of interest that though the lung volumes for healthy Chinese adults in Singapore were less than those of Caucasian subjects standardized for age, height and weight in both sexes (Da Costa, 1971) no significant difference was noted in the PEFR values. It is possible, however, that the larger variations in normal PEFR values may mask small racial differences.

Since its introduction in 1959, the Wright peak flow meter has become widely established as an accurate and simple instrument for assessing ventilatory function. It measures the maximal expiratory flow rate (or PEFR) sustained by a subject for at least 10 milliseconds (expressed in litres/min). This rate is influenced by age, sex, body build and muscular strength and shows a positive correlation with the vital capacity and forced expiratory volume in one second (FEV_1) (Leiner *et al*, 1963; Rosenblatt *et al*, 1963). It may therefore be used as a simple test to assess the reversibility of airways obstruction and the response of an asthmatic patient to bronchodilator therapy. Furthermore, serial PEFR observations in asthma are of great benefit to the physician in his management of the patient. The dyspnoea in severe heart failure may also be differentiated from that due to respiratory disease as the PEFR in the former instance is not severely impaired (Flint and Kahn, 1962). The peak flow meter may also be used in field studies for the detection of ventilatory impairment.

However, the PEFR values do not permit differentiation between a restrictive and an obstructive type of ventilatory defect. In both these defects the FEV_1 is decreased and as PEFR closely correlates ($r=0·5$) with FEV_1 there is too much overlap to permit clear differentiation. It thus cannot replace the measurement of the dynamic lung volumes e.g. FEV_1, forced vital capacity (FVC) and the FEV_1/FVC ratio.

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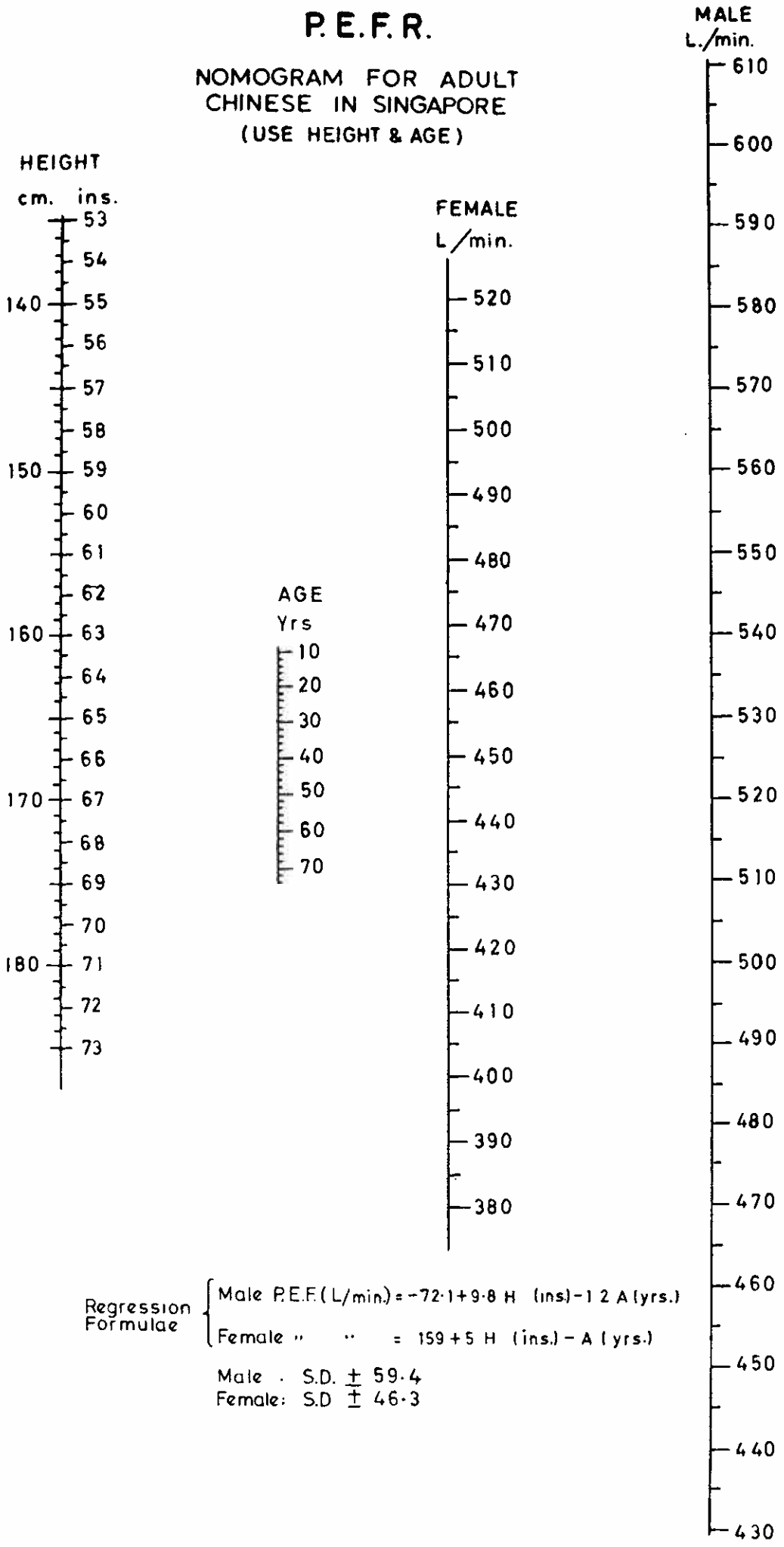

Fig. 1. Nomogram for prediction of PEFR from age and height in male and female Chinese adults.

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