VENTILATORY CAPACITY IN A GROUP OF OPIUM SMOKERS

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Since the description of an abnormal radiographic appearance in some opium smokers (Khoo *et al*, 1960), considerable interest has been shown in the possibility that opium smoking might produce a specific pulmonary disorder. About two-thirds of a series of over 80 consecutive patients admitted to hospital with severe, irreversible obstructive bronchopulmonary disease were noted to be opium addicts (J.L. Da Costa, personal communication); many had carbon dioxide retention and "cor pulmonale". In these circumstances, it seemed pertinent to examine a series of opium addicts who had not presented to a hospital or doctor specifically on account of respiratory symptoms.

PLAN OF STUDY

A series of 27 Indian and Chinese men undergoing treatment at the Opium Treatment Centre on St. John's Island, five miles south of Singapore Island, were investigated. This centre, established in 1955, is Singapore's answer to the problem of treatment and rehabilitation of persons dependent upon drugs; both volunteers and persons convicted for violation of the Dangerous Drugs Ordinance 1951 are committed to it. A general survey of opium addiction treatment and rehabilitation of dependents is given by Leong (1959) and Glatt and Leong (1961). Two subjects were excluded from the study; one had extensive pulmonary tuberculosis, the second a history of "asthma" for three years, with clinical and radiological signs of abnormality of the left lower lobe of indeterminate kind. Both these subjects had severely reduced ventilatory capacity. The remaining 25 subjects had smoked opium for between two and 40 years; some had also taken opium orally or morphine by injection.

All the 21 Chinese had started by smoking opium—they smoked what is called prepared opium, or chandu, which is obtained by "cooking" raw opium. When smoking was not possible they would resort to swallowing the prepared opium. In times of hardship—the majority were from the poorer classes—they would mix the cheaper dross (the calcined remains of prepared opium obtained by scraping the opium pipes) with opium and smoke the mixture.

Eight of the Chinese had also taken morphine by injection. The reasons for switching from smoking opium to morphine injection are generally economic and social; it is cheaper to get an injection of morphine for about 30 cents than to smoke a "packet" of opium for $1.00, which has about the same effect, and one is also less liable to be arrested by the police.

Of the four Indians, Sikh by religion, three had started by smoking opium, and gone on to morphine injection. One started by swallowing opium, then took up smoking and finally changed back to opium swallowing.

The amount of opium smoked varied from two to 10 "packets" per day. Each packet contains an equivalent of about 11.7 grains (0.76 g.) of prepared opium, which ordinarily contains 12 to 15 per cent morphine, provided it is not adulterated. The amount of morphine taken by injection cannot usefully be estimated.

No specific respiratory history was taken except in relation to cigarette smoking. Examination consisted merely in asking each subject to take a deep breath and cough, and in auscultation of the bases, anteriorly and posteriorly. The cough was assessed by ear as loose (productive) or dry (unproductive). Ventilatory capacity tests were performed in the conventional manner with the subject seated. A McDermott spirometer was used; this instrument enables the forced expiratory volume at one second (FEV_1) and the forced vital capacity (FVC) to be read simultaneously from a dial in litres, corrected to body temperature, saturated with water vapour. The highest of several attempts showing reasonably close agreement (within 10 per cent) was accepted. The forced expiratory ratio (FER) was subsequently calculated ($FEV_1/FVC \times 100$).

Chest radiographs were available in all of the subjects, and most were reviewed jointly by the authors. Only three showed any evidence of the reticular pattern described by Khoo and his

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colleagues, and in none of these were the appearances impressive enough to be unanimously regarded as abnormal. After exclusion of the two subjects previously mentioned, none had radiographic evidence of localised disease.

RESULTS

Table I sets out the mean values and ranges for height, age, cigarette and opium smoking habits, observed FEV_1, FVC and FER. Table I also shows the means and ranges for individual predictions of normal values for FVC based on height and weight, using graphs constructed from the data supplied by Bates and Christie (1964) derived from European subjects, and also from similar data for Chinese subjects (Poh and Chia, 1969). Predicted normal values for FEV_1 were obtained by taking an arbitrary percentage of the predicted FVC—80 per cent in the age range 20 to 44 years, 75 per cent between 45 and 59 years, and 70 per cent in those aged 60 years or more. Fig. 1 shows the observed and predicted (Bates and Christie) values for FEV_1 and FVC by age, together with the actual values for FER, in each case; those observed to have a loose cough are shown as triangles and the others as circles.

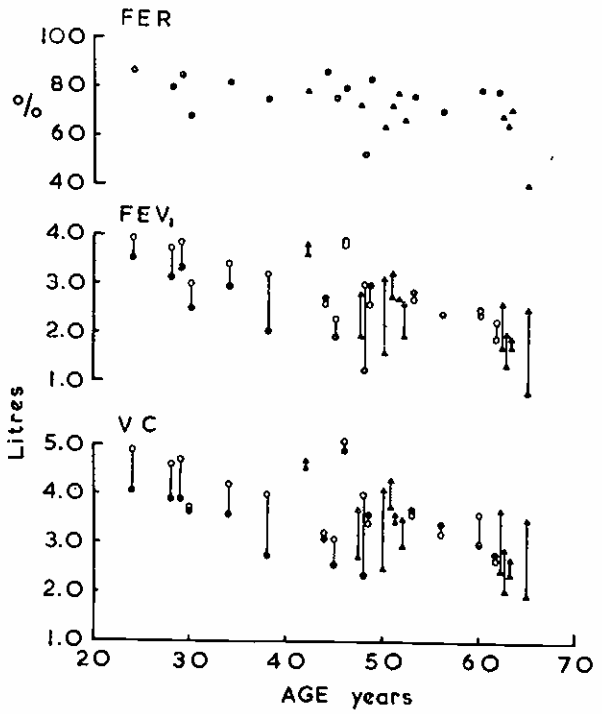

Fig. 1. Values for forced expiratory ratio (FER), forced expiratory volume at one second (FEV_1) and forced vital capacity (VC) plotted against age on the horizontal axis. Those observed to have a loose cough are shown as triangles and the remaining subjects as circles. Open symbols represent predicted values and closed symbols the observed values.

All 25 subjects smoked cigarettes, mostly between 10 and 30 per day, so that it is not possible in this series specifically to examine the effect of smoking. Ten of the 25 (as well, incidentally, as the two subjects excluded because of other pulmonary disease) were observed to have a loose cough; four of these were also noted to have adventitious sounds in the chest, either medium rales or relatively "fine" rhonchi or wheezes. None had the frank wheezing or rhonchi of asthma or other florid obstructive airways disease, and only one had transient fine "bubbling" rales (inspiratory and expiratory) which are particularly associated with chronic bronchiolitis.

Table II shows the mean difference between predicted (Bates and Christie) and observed values for FEV_1 and FVC in those with and those without a loose cough. The former values were obtained by subtracting the predicted from the observed values in each case, adding the differences and taking the mean; this procedure eliminates differences between subjects attributable to age and height. The results show that, whilst there are highly significant decreases for the group as a whole both in FEV_1 and FVC, by comparison with predicted normal values, the differences tend to be greater and more consistent in both parameters in those with a loose cough. In this group, the reduction in FEV_1 and FVC is about 24 per cent and 21 per cent respectively on predicted normal values, by comparison with 11 per cent and 8 per cent for the same measurements in those without a loose cough; the comparisons do not, however, reach statistical significance.

Table III shows the same comparisons using the formula of Poh and Chia, based on data obtained from normal Chinese males†. Analysed in this way, no significant deviation in FEV_1 or FVC from the norm is apparent for the entire series, nor for the group without a loose cough. However, the group with a loose cough shows a significant reduction both in FEV_1 and in FVC. Comparison of the decreases in FEV_1 for those with and without a loose cough is significant ($P < .05$).

Table IV presents an analysis of the observed values for FER. The FER is significantly lower in those with a loose cough than in those with a dry cough. Thus, the findings for the *observed* ratio between FEV_1 and FVC, that is, FER, are consistent with the findings for FEV_1 and FVC when considered separately in terms of

† This approach fails to take account of the four Sikh subjects whose predicted values may thus be under-estimated in this analysis.

TABLE I

BASIC DATA ON THE ENTIRE SERIES

		Mean	Range
Number of Subjects = 25			
HEIGHT	(cms.)	165.1	153 - 185
AGE	(Years)	47.7	24 - 65
CIGARETTES	(Pkt. Years)	25.61	0.2 - 85
DURATION OPIUM	(Years)	18.3	2 - 40
OPIUM PER DAY	(Pkts.)	4.3	0.5 - 10
FVC: OBSERVED	(Litres)	3.196	1.95 -4.90
PREDICTED*	(Litres)	3.79	2.7 - 5.1
PREDICTED[2]	(Litres)	3.42	2.7 - 4.4
FEV_1: OBSERVED	(Litres)	2.406	0.80 -3.90
PREDICTED*[3]	(Litres)	2.88	1.9 - 3.9
PREDICTED[2,3]	(Litres)	2.59	1.9 - 3.3
FER: OBSERVED	(%)	73.78	41.0 -87.1

* Based on data of Bates and Christie (1964).
2 Based on data of Poh and Chia (1969).
3 Calculated from the predicted FVC by using a fixed percentage determined by age (20-44 years 80% of VC; 45-59, 75%, and over 60 years, 70%).

TABLE II

COMPARISON OF OBSERVED-PREDICTED* VALUES FOR FEV_1 AND FVC IN OPIUM SMOKERS WITH AND WITHOUT A LOOSE COUGH

	FEV_1: OBSERVED-PREDICTED			FVC: OBSERVED-PREDICTED		
	TOTAL	With Loose Cough	Without Loose Cough	TOTAL	With Loose Cough	Without Loose Cough
N	25	10	15	25	10	15
$\bar{x}$	—0.474	—0.710	—0.317	—0.592	—0.800	—0.454
s	0.585	0.554	0.569	0.563	0.542	0.551
t	4.051	4.050	2.156	5.258	4.664	3.189
P	<.001	<.01	<.05	<.001	<.002	<.01

* Based on data of Bates and Christie (1964).

TABLE III

COMPARISON OF OBSERVED-PREDICTED* VALUES FOR FEV_1 AND FVC IN OPIUM SMOKERS WITH AND WITHOUT A LOOSE COUGH

	FEV_1: OBSERVED-PREDICTED			FVC: OBSERVED-PREDICTED		
	TOTAL	With Loose Cough	Without Loose Cough	TOTAL	With Loose Cough	Without Loose Cough
N	25	10	15	25	10	15
$\bar{x}$	—0.186	—0.480	+0.01	—0.220	—0.490	—0.041
s	0.594	0.584	0.531	0.575	0.611	0.490
t	1.566	2.597	0.073	1.913	2.534	0.321
P	>.1	<.05	>.1	<.1>.05	<.05	>.1

* Based on data of Poh and Chia (1969).

their relation to predicted values. It may be argued that the older age of those with a loose cough (55 years), by comparison with the age of men with a dry cough (43 years) is responsible for the observed difference in FER, but in fact, for the series as a whole, the change in FER is approximately 4 per cent per decade. Age is therefore unlikely to be the sole factor in the low FER in those with a loose cough.

TABLE IV

COMPARISON OF OBSERVED FER IN OPIUM SMOKERS WITH AND WITHOUT A LOOSE COUGH

		(FER Observed)	
	TOTAL	With Loose Cough	Without Loose Cough
N	25	10	15
$\bar{x}$	73.78	68.15	77.53
s	10.42	10.79	8.58
t		2.418	
P		<.05	

The possibility exists that the differences in ventilatory capacity between those with a loose and those with a dry cough were attributable to differences in cigarette smoking, especially as the former had smoked an average of 35 packet-years and the latter only 19 packet-years (the difference is not statistically significant). This was examined by comparing differences between observed and predicted values for FEV_1 and FVC in the 10 heaviest cigarette smokers and in the remainder. Table V indicates that no significant differences were found between the heavier and the lighter smokers. This suggests that, in these smokers of cigarettes and opium, the presence of a loose cough rather than the amount of cigarette smoking is the factor more directly associated with reduction in ventilatory capacity. The average duration of opium smoking was 10 years in those with a loose cough and 16 years in those with a dry cough; the difference is not significant.

The three subjects with doubtful radiological changes showed no consistent pattern of change in ventilatory capacity; a larger series, including subjects with more definitive radiographic abnormality, is required to study this aspect.

DISCUSSION

Of the original 27 subjects, one had tuberculosis, one had localised clinical signs and a related radiographic opacity (no diagnosis had been established), four had adventitious sounds in the chest and a productive cough, and six more had a productive cough without abnormal chest signs. These findings suggest a high prevalence of chronic respiratory disease, but the prevalence of a productive cough, as here defined, in the general male population of Singapore has yet to be determined.

If the European normal standards are accepted, then the series as a whole shows a lowering of FEV_1 and of FVC by comparison with normal.

TABLE V

COMPARISON OF OBSERVED-PREDICTED* VALUES FOR FEV_1 AND FVC IN THE TEN HEAVIEST CIGARETTE SMOKERS AND THE REST OF THE SERIES

	FEV_1: OBSERVED-PREDICTED			FVC: OBSERVED-PREDICTED		
	TOTAL	Heaviest Smokers	The Rest	TOTAL	Heaviest Smokers	The Rest
N	25	10	15	25	10	15
$\bar{x}$	−0.186	−0.145	−0.213	−0.220	−0.168	−0.255
s	0.594	0.510	0.660	0.575	0.536	0.616
t	1.566	<1	1.249	1.913	<1	1.602
P	>.1	>.1	>.1	<.1	>.1	>.1

* Based on data of Poh and Chia (1969).

This would implicate opium smoking as the most likely responsible factor. On the other hand, if the assessment is based on the normal standards of Poh and Chia, the decrease in both parameters for the series as a whole does not significantly differ from normal, consistent with the view that opium smoking does not adversely affect ventilatory capacity. Neither approach is wholly satisfying, and the problem must await the study of larger series of normal subjects and of opium smokers.

When the series is divided into those with and without a productive cough, the findings by either method of analysis are concordant. Those subjects with a productive cough, as judged by the sound made during a deliberate cough upon request, have a significant and considerable reduction in FEV_1 and in FVC; relatively, the fall tends to be a little higher in FEV_1 than in FVC. This finding is supported by the lower mean FER observed in those with a loose cough. As both groups smoked opium and cigarettes, it is difficult to apportion responsibility to either habit; the amount of opium smoked was roughly comparable in the two groups, and although the men with a loose cough tended to be heavier cigarette smokers, the analysis presented in Table V does not suggest that this was the sole determining factor.

A comprehensive interpretation of the data presented in this paper must await further information. Apart from the question of normal standards for ventilatory capacity in smokers and non-smokers of all racial groups, it would be desirable to know the prevalence of a loose cough, as defined, and of adventitious sounds in the chest in the Singapore general population, as well as the influence of cigarette smoking, and possibly other factors, in producing them. It will be advantageous to extend the present study of opium smokers progressively, particularly to acquire gradually a group with radiographic abnormality, and perhaps a group who smoke few or no cigarettes. The possibility that men with respiratory disease tend to take up opium smoking also requires further examination; this hypothesis could account for the present findings, although it appears an unlikely explanation in men not presenting with respiratory symptoms and with a comparatively small loss of ventilatory capacity as a group.

In the absence of this information, the present study of men who did not present because of respiratory symptoms should be regarded merely as revealing that a notably high proportion of opium smokers has some evidence of chronic respiratory disease and a notably high proportion has significant lowering of ventilatory capacity.

From the clinical viewpoint, it can be concluded that the presence of cough and sputum in an opium smoker implies, on the average, a not inconsiderable loss of ventilatory capacity. Whether or not this is specifically related to opium, and whether or not the condition progresses to serious clinical disability, as hospital experience suggests, are matters for further study.

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REFERENCES

1. Bates, D.V., and Christie, R.V. (1964): "*Respiratory Function in Health and Disease.*" W.B. Saunders Company, Philadelphia.
2. Glatt, M.M., and Leong, H.K. (1961): "Alcohol Addiction in England and Opium Addiction in Singapore. Some Differences and Similarities." Psychiatric Quarterly, 35:1.
3. Khoo, F.Y., Toh, C.H., and Leong, H.K. (1960): "An Unusual Form of Reticulated Lung Disease, Probably an Unidentified Type of Pneumoconiosis—A Preliminary Report." Singapore Med. J., 1:96.
4. Leong, H.K. (1959): "Opium Addiction in Singapore." Dissertation for D.P.H. (London).
5. Poh, S.C., and Chia, M. (1969): "Respiratory Function Tests in Normal Adult Chinese in Singapore." Singapore Med. J., 10: 265.