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DAILY CIGARETTE CONSUMPTION AND LUNG FUNCTION: A STUDY OF PEAK EXPIRATORY FLOW RATES

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Summary

Daily cigarette consumption influences the degree of airflow obstruction recorded each day using a peak expiratory flow meter. This daily effect was more marked in smokers with the lowest initial values for lung function.

Résumé

La consommation quotidienne des cigarettes exercé une influence certaine sur le niveau d'engouement respiratoire si l'on mesure celui-ci, chaque jour, avec un debitmetre de niveau maximal de l'expiration. Cet effet journalier a été particulièrement marqué chez les fumeurs presentant les taux de fonctionnement pulmonaire les plus bas.

Introduction

Cigarette smoking is well known to be associated with reduced lung function as well as increased mortality from chronic bronchitis and emphysema (Royal College of Physicians, 1962; Doll & Hill, 1964). The increased airway resistance observed after a single cigarette is smoked is well documented. (Nadel & Comroe, 1961; Zamal, Youseff & Prinie, 1963). It has been suggested that this reported increase in airway resistance is due to the irritant action of smoke particles on receptors in the bronchial tree (Sterling, 1967). McDermott and Collins (1965) concluded in their study that the airway resistance of 'bronchitics' (including those with only minimal abnormality) was higher than in those with no respiratory symptoms. The airway resistance also varied from day to day in the bronchitics. However, the variation in airway resistance referred to in the above study was not explained. This study was addressed to finding out how daily cigarette consumption influences the day-to-day fluctuation in lung function. On days of heavy cigarette consumption, is lung function worse than on days of low consumption?

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Materials and methods

Fourteen patients attending the chest clinic volunteered for the study. All the subjects were smokers – by which is meant anybody who smokes at least one cigarette/day for at least 1 year. No patient was classified as asthmatic using criteria of greater than 20% variation in forced expired volume in one second (FEV_1), or personal or family history of atopy. Each of the subjects was instructed on how to use and take readings accurately from the mini peak flowmeter. (Wright, 1978). They were taught to record the best of three expiratory flow rate (PFR) values obtained at any particular time. Observations were to be made four times daily with approximate interval of 3 h between each reading, so as to allow for adequate representation over the waking hours of the day. All the subjects were requested to make the recordings as near as possible to the last cigarette smoked. The subjects were also asked to record the number of cigarettes smoked on any particular day. The study was carried out over a 5-day period

on an outpatient basis, while the subjects continued their routine daily activities.

Results

There were nine males and five females aged between 38 and 60 years (see Table 1).

For each patient the mean and standard deviation of the PFR recording every day were calculated. The predicted PFR was obtained taking the patient's age, sex and height into consideration (Cotes, 1978). In order to standardize the observations for individual differences, the results were expressed as a percentage of predicted.

Figure 1 shows a graph of % PFR against the number of cigarettes smoked in all the patients studied. From the figure there appear to be two distinct groups; those patients having % PFR >70% and those with % PFR <60%.

Peak expiratory flow rate was inversely correlated to daily cigarette consumption in both groups, but more significantly in those with PFR lower than 60% (PFR>70%: $r = -0.71$, $P<0.02$, $t = 4.83$; PFR<60%: $r = -0.84$, $P<0.01$, $t = 10.15$).

However, the variation (s.d.) of the PFR during each day showed no relationship with the number of cigarettes smoked ($P>0.1$).

Discussion

Daily cigarette consumption does influence lung function. Production in FEV_1 is related to daily number of cigarettes smoked (Higenbottam *et al.*, 1980). Ceasing to smoke may not lead to an improvement in FEV_1, (Ross & Hamilton, 1978). We have demonstrated that in individuals with poor lung function, daily cigarette consumption may influence the daily values recorded with a peak

TABLE 1. Peak expiratory flow rates as percentages of predicted values on the various days of study and the number of cigarettes smoked by the patients

Patients	Sex	Age (years)	Cigarette consumed on different days					PFR (l/min) as % of predicted value on different days				
			1	2	3	4	5	1	2	3	4	5
1	M	53	20	26	23	0	22	420 70%	460 76%	485 80%	465 77%	485 80%
2	F	50	15	15	10	17	12	185 40%	165 36%	215 47%	150 33%	135 30%
3	F	42	1	0	1	2	1	340 85%	350 88%	360 90%	365 92%	355 89%
4	M	46	0	0	0	0	0	340 57%	350 58%	340 57%	340 57%	350 58%
5	M	52	6	5	6	7	6	275 45.5%	250 42%	290 48%	290 48%	280 47%
6	F	56	5	5	3	5	1	205 42%	215 44%	220 45%	220 45%	215 44%
7	M	38	16	15	30	22	23	470 73%	495 77%	475 74%	480 75%	500 78%
8	M	43	3	1	2	5	0	305 47%	320 50%	335 53%	340 53%	310 49%
9	M	60	0	3	2	0	5	290 50%	310 53%	300 52%	280 48%	300 52%
10	F	54	10	12	17	18	18	150 41%	140 38%	150 41%	130 35%	135 32%
11	M	66	20	23	25	25	26	140 30%	155 33%	140 30%	160 34%	150 32%
12	M	59	5	5	5	5	3	450 90%	425 85%	425 85%	435 87%	425 85%
13	M	50	10	10	12	10	10	375 75%	385 77%	375 75%	400 80%	400 80%
14	F	55	10	12	15	20	15	190 55%	165 48%	140 40%	155 45%	140 40%

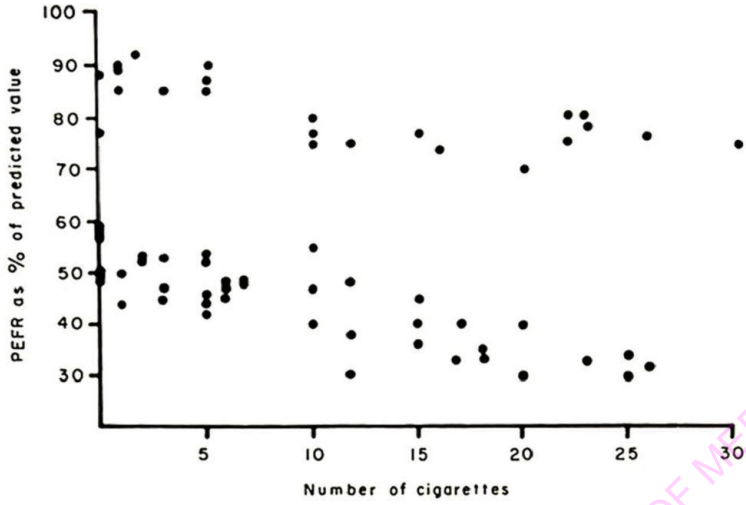

FIG. 1. Relationship between peak expiratory flow rates (PFR) as percentage of predicted values and the number of cigarettes consumed per day in the fourteen subjects studied.

expiratory flow gauge. On low cigarette consumption days, peak flow improved, declining on heavy consumption days. The variation in recording with 1 day, however, was little affected by cigarette consumption.

It is important to question first the accuracy of peak flow measurement at home. Evidence has been presented that this is reproducible and accurate, provided, as in our patients, careful instruction was given (Hetzel, Williams & Shakespear, 1979). Secondly, the possibility arises that individuals with asthma may have been included, who possibly are more reactive to tobacco smoke. However, in acute provocation studies, asthmatics show no more frequent episodes of bronchoconstriction after a cigarette than normal individuals and therefore unlikely to differ greatly from non-asthmatic individuals.

We would suggest that individuals with low levels of lung function are more prone to sustained effects of tobacco smoke inhalation than individuals with normal lungs. This is consistent with the view of Fletcher and co-workers who identified individual workers likely to undergo rapid decline in lung function by their low values of FEV_1, (Fletcher *et al.*, 1976). Perhaps this reflects the unequal distribution of inhaled tobacco smoke in the lungs of people with airways obstruction as has been described for inhaled aerosols (Harumi *et al.*, 1977). This would lead to excessive concentration of tobacco smoke constituents at already compromised parts of the intrapulmonary airways.

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