LUNG FUNCTION IN ROYAL NAVY FIREFIGHTING INSTRUCTORS

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INTRODUCTION

The Royal Navy (RN) provides basic training in firefighting techniques which enable firefighters to deal with shipboard fires. Training includes fighting diesel, wood and oil fires to which instructors may be exposed for up to 4 hours per day, for 3 to 5 days each working week for two years. The instructors wear a cotton 'anti-flash' hood; this hood does not have a filter and provides no respiratory protection. Previous investigation' of 39 instructors concluded that this type of exposure resulted in decrements to their gaseous diffusion and expiratory flow parameters; the aim of this study was to validate these findings with a larger number of instructors.

METHOD

Procedure: 133 RN firefighter instructors had their lung function measured on the following occasions: on joining the fire school, annually, upon leaving the fire school and finally at least 6 months after leaving the fire school. Forced spirometry, single breath transfer factor, and lung volumes obtained by helium dilution were measured and calculated using standard gas analyzers and a commercial software package (PK Morgan, UK). The tests were performed in accordance with the methods described by the American Thoracic Society'[3,4] and PK Morgan'.

Statistical analysis: The distributions of the pre-exposure lung function measures of the instructors were investigated and the Box-Cox transformation applied. Weighted and unweighted multiple regression analysis on actual or transformed data were conducted, to assess any changes that can be attributed to the exposure time at the schools, after allowing for changes attributable to height and age. The lung function relationship to age and height has been examined, and is summarised by Cotes[6].

The following maximal lung function model was used in the estimations of lung function:

$$g(y) = a + b * \text{height} + c * \text{age} + d * \text{age}' + e * \text{firetime}$$

where: g(y) is a function (eg. logarithm. square root, identity) of y (any lung function measured or derived), height (metres), age (years), firetime (years at the firefighting school), and 'a, b, c, d, e, f' are parameters estimated by 'weighted' or 'unweighted' least squares analysis.

RESULTS

At the time of their first lung function measurements 76 instructors were smokers, 28 were ex-smokers and 29 were non-smokers. The characteristics and lung function measurements for the 133 instructors are summarised in the following table.

	Mean	S.D.
Age (years)	30	5.7
Height (metres)	1.76	0.07
Weight (kg)	82.8	12.3
Forced vital capacity (litres) (FVC)	5.38	0.77
Forced expiratory volume 1 sec (litres) (FEV_1)	4.31	0.7
FEV^1 / FVC (%)	80.6	5.4
Diffusing capacity for carbon monoxide (mmol $CO.min^{-1}.kPa^{-1}$) (DLCO)	11.97	1.97
Effective alveolar volume (litres) (V_A)	6.84	1.04
Total lung capacity (litres) (TLC)	6.88	0.98

Results from the various analyses (all instructors; subgroups according to their smoking habits) were examined and the summary findings presented below are based on the 'weighted' analyses. weighted according to the number of measurement occasions.

For the 29 non-smokers, no changes in lung function were found other than those associated with age (ie. no 'effects' attributed to time at the fire-fighting school). For the 76 smokers, a significant ($P<0.05$) change in DLCO could be attributed to factors other than ageing, with a reduction in DLCO of 3% per year above that expected to occur. In addition there were significant changes in V_A ($P<0.01$) and slow vital capacity ($P<0.05$) greater than expected to occur by ageing, with these parameters falling an extra 4% and 2% per annum respectively.

CONCLUSION

No adverse effects of firefighting training on lung function could be found in the small group of non-smoking instructors. Instructors who smoked were found to have larger changes (reductions) in some lung function measures over and above those expected through ageing. In the previously mentioned study' it was not possible to distinguish between instructors who smoked and those that did not, and it is possible that the findings of that study were attributable to cigarette smoking as opposed to smoke exposure on the fireground.

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