

Respiratory morbidity and exercise-induced bronchoconstriction in children

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SUMMARY. A sample of 99 children had lung function tests before and after exercise. Sixteen had a decrease in lung function after exercise (forced expiratory flow) of more than 20 per cent, which indicated an important degree of exercise-induced bronchospasm. Review of the medical records for the total sample revealed that those with exercise-induced bronchospasm had a higher consultation rate for respiratory symptoms, while their consultation rate for non-respiratory symptoms was the same as the remainder of the sample. These findings suggest that bronchial lability may be a predisposing factor in some respiratory diseases.

Introduction

PATIENTS with asthma will suffer a maximum change in bronchoconstriction three to five minutes after running on level ground for six minutes (Godfrey *et al.*, 1973). The degree of bronchial lability in the non-asthmatic population after exercise has been shown to be very wide (Silverman and Anderson, 1972). It has also been shown that maximum bronchoconstriction occurs between two and 10 minutes after stopping exercise (Godfrey *et al.*, 1973), and that the lowest forced expiratory volume and lowest peak expiratory flow occurs and is reached at about three to five minutes after stopping exercise (Anderson *et al.*, 1975). An abnormal degree of lability has often been shown in the relatives of asthmatics and in children with a history of wheezy bronchitis (Konig *et al.*, 1972 and 1973).

Aim

The purpose of this investigation was to determine whether children with increased bronchial lability sought medical treatment for respiratory symptoms more frequently than other children.

Method

Population

A stratified random sample of nine and 10-year-old children attending the same junior school was prepared. Since we wished to study 100 children, but only those registered with the university teaching practice, it was necessary to stratify the population to retain correct representation for age and sex. From the stratified population, a random selection was made from the children and their parents. Finally, a study population of 99 children was identified.

Data collected

A history of asthma, wheezing, hayfever, eczema, or croup was obtained about each child from the parents by questionnaire. The total number of consultations and the presenting symptoms for each were recorded on special forms, stored in each child's medical record, for a six-month period (September to February inclusive). The number of days absent from school for the previous year was obtained from the school records. Each child was measured for height and weight and spirometry* recordings were made before and after six minutes of exercise. From these tracings the following measurements were taken: Forced Expiratory Volume (FEV)** at 0.5, 0.75, and 1.0 second; Forced Expiratory Flow

* Standard vitalograph spirometer was used. The current cost is about £400.

**Corrected to body temperature, pressure (prevailing atmospheric), and saturation (water vapour)(BTPS).

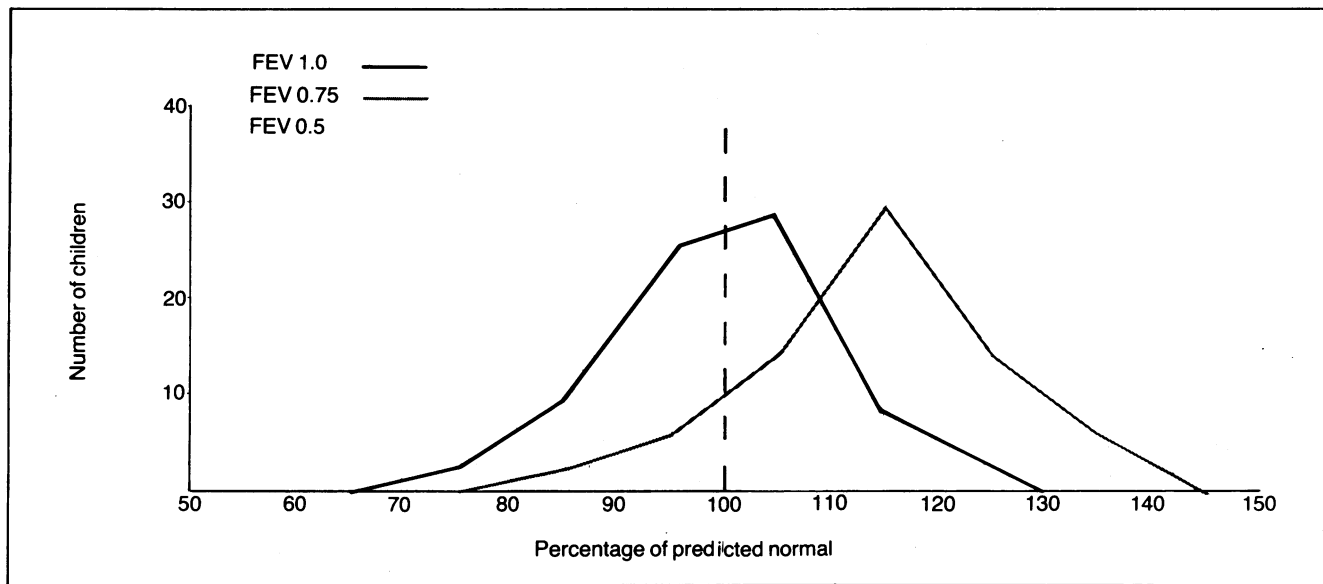


Figure 1. Distribution of FEVs at 1.0, 0.75 and 0.5 seconds as a percentage of predicted normal (100) in study population (Lunn, 1965; Godfrey et al., 1970).

Table 1. Number of children with percentage changes in FEV_x and FEF.

		No	Decrease	Decrease	Decrease
	Increase	change	<10	10 to 20	>20
			per cent	per cent	per cent
FEV _{0.5}	11	10	58	7	4
FEV _{0.75}	15	2	65	5	3
FEV _{1.0}	16	6	62	3	3
FEF 200 to 1200 ml	17	5	28	24	16

(FEF) between 200 and 1,200 ml; Forced Vital Capacity (FVC)**. The pulse rate was measured before and after exercise.

Exercise test

The children ran round the school playground for six minutes. They were allowed to set their own speed but were not allowed to stop running during the test. Spirometry recordings were made three to five minutes after they had stopped running.

All children with a history of asthma, and those with FEV₁ value of less than 50 per cent of the predicted normal were excluded from the exercise test.

Results

Population characteristics

1. The study population had a normal distribution for height and weight using standard growth charts (Tanner et al., 1966).

2. Pre-exercise lung function measurements indicate a normal distribution of FEV₁ at the predicted level (Figure 1). However, FEV_{0.5} and FEV_{0.75}, while retaining a normal distribution, had a significantly higher median than predicted ($p < 0.001$), which we do not consider to have any clinical importance.

Exercise test

Eight children had a positive history of asthma and one pre-exercise spirometry tracing was technically unsatisfactory. Therefore, of the 99 children in the study, 90 participated in the exercise test.

Table 1 shows the changes in the lung function tests after exercise, which clearly show that FEF was found to be the most sensitive measurement of those made. Of the 16 who had a decrease in FEF of more than 20 per cent, 11 had a decrease of more than 10 per cent in FEV_{0.5}. On the basis of these tests, 16 children were deemed to have increased bronchial lability on the basis of a fall in FEF of more than 20 per cent.

We had identified three groups of children within the study population: those with a history of asthma, those with increased bronchial lability, and the remainder—'normal children'. We compared the three groups for respiratory and non-respiratory consultations and responses to the questionnaire.

No difference was shown between the groups for non-respiratory consultations. However, for respiratory problems differences did exist (Table 2). It can be seen that there is a gradient of increasing respiratory consultations from normal children, through those with bronchial lability to asthmatics, although this was not statistically significant. ($p < 0.3$).

The results of the questionnaire show that 35 individuals had at least one positive response, and some of them had more (Table 3).

Table 2. Number and percentage of children in each group who had consultations for respiratory problems.

	Total	With respiratory consultations	
		Number	Percentage
Normal children	74	12	16.2
Increased bronchial lability	16	4	25.0
Asthmatic children	8	4	50.0

Table 4 compares the 'normal' group with the labile group for positive responses to questions of wheeze, hayfever, and eczema (asthmatic children are not included). Of the normal group, 17.8 per cent gave positive results compared with 25 per cent of the labile group.

Finally, no significant difference was discovered between the three groups in connection with absence from school.

Discussion

It has been shown by other workers that a proportion of children have increased bronchial lability which can be induced by exercise. We found this a slightly higher proportion than was found in a sample of Welsh schoolchildren (11.4 per cent) using a peak flow meter (Burr *et al.*, 1974). We feel that the Forced Expiratory Flow calculated from the first 200 ml to 1,200 ml of expelled air is a more accurate measurement, since the shape of the curve on the recordings give a clear indication of the value of each test. For example, a wobbly curve indicates that maximum effort is not being consistently applied, and no such quality check is possible with the peak flow meter.

The increase in respiratory symptoms of the group with increased bronchial lability suggests that they could be labelled as being currently 'at risk' for respiratory problems and possibly in the future they may be more prone to the development of obstructive airways disease. However, we have no evidence to support this.

We find the questionnaire has little value in identifying the group of children with increased bronchial lability. Even although a positive response was more likely to occur in this group, the questionnaire had a low sensitivity and would not be useful as a screening method to identify these children.

We had originally felt that the parents of asthmatic children might show a degree of 'overprotectiveness' towards them, but since the non-respiratory consultation rates were the same for each of the groups, this does not appear to have been so. We feel this underlines the importance of the increased consultation rate for respiratory problems of those children with increased exercised-induced bronchoconstriction.

Table 3. Positive responses to questionnaire (97 questionnaires completed).

	Positive replies	
	Number	Percentage
Asthma	8	8.2
Wheezing	6	6.2
Croup	12	12.4
Hay fever	11	11.3
Eczema	11	11.3

Table 4. Positive responses to questions of wheeze, hay fever, and asthma for 'normal' children and those with increased bronchial lability. (Asthmatic children not included.)

	Positive		
	Total	reply	Percentage
Normal children	73	13	17.8
Increased bronchial lability	16	4	25.0
Total non-asthmatic population	39	17	19.1

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