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# Exercise-induced Bronchial Lability in Children with a History of Wheezy Bronchitis

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**König, P., Godfrey, S., and Abrahamov, A. (1972).** *Archives of Disease in Childhood*, **47**, 578. **Exercise-induced bronchial lability in children with a history of wheezy bronchitis.** Exercise tests were carried out on 18 children who had had wheezy bronchitis under the age of 5 years during hospitalization 7 years previously. A control group of 12 children who had been hospitalized with gastroenteritis at the same time were also studied. It was found that there was still a significant increase in bronchial lability among the wheezy bronchitis group compared with the controls, and this was especially obvious in the 7 children who had continued to have mild episodes of wheezing.

It is suggested that the same abnormal mechanism operates in at least some cases of wheezy bronchitis as it does in asthma.

Wheezy bronchitis (sometimes called 'spastic bronchitis') is a frequent problem in infancy in Israel. Despite this frequency, however, there is still no agreement on its relation to bronchial asthma. In fact, Williams and McNicol (1969) concluded on the basis of clinical studies that there was no difference between the conditions. The fundamental feature of asthma is reversible airways obstruction, and it was shown by Jones, Buston, and Wharton (1962) that this phenomenon could be demonstrated very simply by stressing the asthmatic child with a few minutes of running. Moreover, in a later publication from this group, Jones and Jones (1966) found that bronchial lability could be produced by exercise in subjects who were asthmatic but who had not had any attacks for many years. We therefore decided to apply the same type of testing to children who had suffered from wheezy bronchitis in infancy in order to see if they had more or less bronchial lability than did a control group of children.

## Subjects and Methods

Letters were sent to parents of 48 children who had been admitted to the paediatric department of Bikur Holim Hospital in 1964 with an indexed diagnosis of spastic bronchitis or bronchopneumonia with a 'spastic component'. Letters were also sent to the parents of 37 children who had been hospitalized in the same year with a diagnosis of gastroenteritis to serve as a control group. All the children were under 5 years old in 1964 and hence were 6 to 9 years old in 1971 and able to co-operate with testing. In all, 18 of the children with wheezy bronchitis and 12 of the gastroenteritis group presented for investigation. No attempt was made to trace the cause of defaulting in the other children.

Each child was examined clinically and a history was obtained from the mother using a standardized questionnaire, with particular emphasis on asthmatic symptoms—namely, recurrent attacks of wheezing, nocturnal wheeze or cough, and post-exertional wheeze or cough. Questions were also asked about personal or familial allergy. At the time of study all the children were asymptomatic and no abnormalities were present on physical examination.

An exercise test was performed on every child after the manner of Connolly and Godfrey (1970). The child ran continuously round a courtyard for 6 minutes. Peak expiratory flow rate (PEF) was recorded with a Wright meter (Airmed Ltd.) before and at 2-minute intervals during exercise, and then with decreasing frequency for 10 minutes after stopping. At the end of the test the child was given an inhalation of a bronchodilator (Salbutamol) followed by one minute of running and a final measurement of PEF. Various indices of lability were calculated from these observations as follows:

$$\text{(a) \% Rise} = \frac{\text{Highest recorded PEF} - \text{resting PEF}}{\text{Resting PEF}} \times 100$$

$$\text{(b) \% Fall} = \frac{\text{Resting PEF} - \text{lowest recorded PEF}}{\text{Resting PEF}} \times 100$$

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(c) Exercise lability % = % rise + % fall

Expected normal values for PEF were taken from the data of Godfrey, Kamburoff, and Nairn (1970).

## Results

On the basis of the questionnaire it was established that 7 of the 18 children who originally suffered from wheezy bronchitis had continued to have respiratory symptoms and were clearly mild asthmatics. Among these 7 children were 2 with family histories of allergy and 1 with a family history of asthma. In the remaining 11 children from the wheezy bronchitis group (all of whom stopped having symptoms at or before the age of 4 years), there were 6 children with family histories of allergy and 3 with a family history of asthma. Among the 12 children from the gastroenteritis (control) group, there were 3 children with family histories of allergy and 1 with a family history of asthma but none of them had asthmatic symptoms. Though the children from the wheezy bronchitis group thus appeared to have a higher incidence of family atopy, the numbers were too small to reach statistical conclusions ($P = 0 \cdot 12$). However, at least 7 of them had clearly developed asthma while none of the control group had done so. It was noted that these 7 children were smaller than the other children in the wheezy bronchitis or control groups and males predominated heavily (Table I).

The individual and grouped results of the exercise tests are given in Table II and the Fig. For the sake of analysis, the wheezy bronchitis group

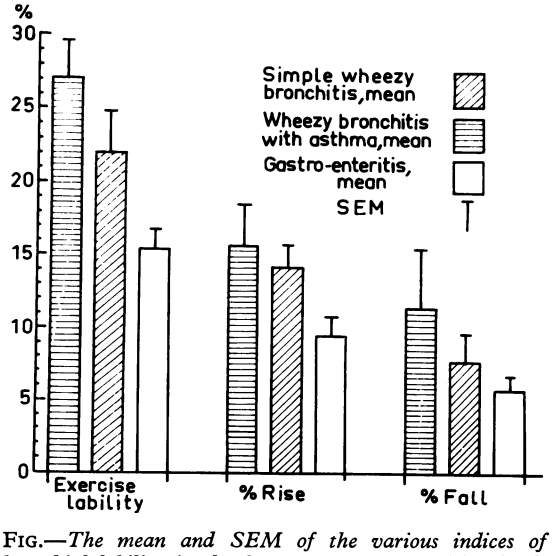


FIG.—*The mean and SEM of the various indices of bronchial lability in the 3 groups: gastroenteritis, simple wheezy bronchitis, and wheezy bronchitis with asthma.*

TABLE I

*Age, Sex, Height, and Weight of Subjects*

| | Gastro-enteritis | Simple Wheezy Bronchitis | Wheezy Bronchitis and Asthma |
|---|---|---|---|
| Males | 7 | 5 | 6 |
| Females | 5 | 6 | 1 |
| Age (yr) | | | |
| Mean | 7·4 | 7·2 | 7·5 |
| SEM | 0·2 | 0·3 | 0·3 |
| Height (cm) | | | |
| Mean | 120·2 | 121·9 | 116·9 |
| SEM | 1·6 | 2·3 | 1·9 |
| Weight (kg) | | | |
| Mean | 22·3 | 24·3 | 22·7 |
| SEM | 0·8 | 1·3 | 0·9 |

TABLE II

*Individual and Group Results of Exercise Tests*

| Case No. | Resting PEF (%) | Exercise Lability (%) | % Rise in PEF | % Fall in PEF |
|---|---|---|---|---|
| *Gastroenteritis* | | | | |
| 1 | 92 | 16 | 5 | 11 |
| 2 | 91 | 17 | 15 | 2 |
| 3 | 95 | 10 | 5 | 5 |
| 4 | 116 | 23 | 14 | 9 |
| 5 | 125 | 20 | 16 | 4 |
| 6 | 103 | 22 | 14 | 8 |
| 7 | 124 | 13 | 11 | 2 |
| 8 | 124 | 9 | 9 | 0 |
| 9 | 97 | 13 | 6 | 7 |
| 10 | 98 | 16 | 5 | 11 |
| 11 | 135 | 7 | 5 | 2 |
| 12 | 107 | 13 | 11 | 2 |
| Mean | 109 | 14 | 9 | 5 |
| SD | 15 | 5 | 4 | 4 |
| SEM | 4 | 1 | 1 | 1 |
| *Simple Wheezy Bronchitis* | | | | |
| 13 | 105 | 28 | 14 | 14 |
| 14 | 87 | 24 | 18 | 6 |
| 15 | 76 | 13 | 10 | 3 |
| 16 | 61 | 46 | 28 | 18 |
| 17 | 104 | 19 | 15 | 4 |
| 18 | 96 | 17 | 15 | 2 |
| 19 | 87 | 15 | 10 | 5 |
| 20 | 116 | 27 | 11 | 16 |
| 21 | 88 | 19 | 16 | 3 |
| 22 | 113 | 9 | 9 | 0 |
| 23 | 91 | 24 | 10 | 14 |
| Mean | 93 | 22 | 14 | 8 |
| SD | 16 | 10 | 6 | 7 |
| SEM | 5 | 3 | 2 | 2 |
| *Wheezy Bronchitis with Asthma* | | | | |
| 24 | 92 | 42 | 12 | 30 |
| 25 | 86 | 22 | 22 | 0 |
| 26 | 110 | 30 | 15 | 15 |
| 27 | 72 | 22 | 22 | 0 |
| 28 | 129 | 23 | 5 | 18 |
| 29 | 84 | 25 | 25 | 0 |
| 30 | 91 | 26 | 9 | 17 |
| Mean | 93 | 27 | 16 | 11 |
| SD | 18 | 7 | 8 | 12 |
| SEM | 7 | 3 | 3 | 4 |

has been subdivided into those 7 children who developed asthma (wheezy bronchitis with asthma), and those who had no further illness (simple wheezy bronchitis).

Resting PEF was significantly lower in the wheezy bronchitis groups compared with the control group ($0{\cdot}05 > P > 0{\cdot}02$) but there was no difference between the wheezy bronchitis children with or without asthma.

There was a significant increase in lability in the wheezy bronchitis with asthma group and the simple wheezy bronchitis group ($P < 0{\cdot}05$) compared with the control group. There was no significant difference between the wheezy bronchitis groups with or without asthma. However, the lability in the simple wheezy bronchitis group was mainly attributable to an ability to dilate, while in those children with asthmatic symptoms there was a significant contribution from both dilatation and postexercise constriction (Table II).

Taking the upper limit of normal exercise lability as the mean of the control group + 2 SD, (i.e. 25%), 4 out of the 7 children in the asthma group and 3 out of the 11 children in the simple wheezy bronchitis group fell above this level. All 7 of the asthma group and 5 of the 11 in the simple wheezy bronchitis group fell above 1 SD over mean normal exercise lability.

## Discussion

This study has shown that bronchial lability is higher in 6- to 9-year-old children who suffered from wheezy bronchitis in infancy than in children who suffered from gastroenteritis. This difference was especially marked in the 7 children who had continued to have symptoms. The degree of lability was lower than the 66% seen in a group of institutionalized asthmatics by König, Abramov, and Godfrey (1971), but the children with asthma in the present study were so mildy affected that their management presented no problems. The similarity of the mild asthmatics to the usual childhood asthmatic can be seen from the preponderance of males, the associated allergies, and the reduced height. The lability found in the present control group was virtually identical to that found in normal subjects by Anderson, Connolly, and Godfrey (1971).

These findings, together with the possible increase in family history of atopy, suggest that wheezy bronchitis does indeed occur against a background of increased bronchial lability. However, this lability is so mild that it does not necessarily cause troublesome asthma later. Freeman and Todd (1962) found an increased incidence of major allergy or asthma among children who had earlier suffered from wheezing during viral infections. It was not possible to distinguish the simple wheezy bronchitis patients from those who later developed asthma statistically in terms of resting PEF or exercise lability, but the numbers involved were small.

In a population study carried out in Australia, Williams and McNicol (1969) found similar qualitative characteristics in terms of several features in children with 'asthma' and 'wheezy bronchitis'. The asthma group tended to show greater quantitative abnormality, but both groups were different from a control group. They felt that 'children with wheezy bronchitis and asthma were from the same population with the same underlying basic disorder'.

We conclude from our studies that children with increased bronchial lability are liable to wheeze if they develop bronchitis in infancy and some may later develop frank asthma. In this study, the lability was not marked enough to cause troublesome asthma, but we see no clear distinction between wheezy bronchitis and asthma in the sense that all these children have abnormally labile bronchi.

### References


Anderson, S. D., Connolly, N. M., and Godfrey, S. (1971). Comparison of bronchoconstriction induced by cycling and running. *Thorax*, **26**, 396.

Connolly, N., and Godfrey, S. (1970). Assessment of the child with asthma. *Journal of Asthma Research*, **8**, 31.

Freeman, G. L., and Todd, R. H. (1962). The role of allergy in viral respiratory tract infections. *American Journal of Diseases of Children*, **104**, 330.

Godfrey, S., Kamburoff, P. L., and Nairn, J. R. (1970). Spirometry, lung volumes and airway resistance in normal children aged 5–18 years. *British Journal of Diseases of the Chest*, **64**, 15.

Jones, R. H. T., and Jones, R. S. (1966). Ventilatory capacity in young adults with a history of asthma in childhood. *British Medical Journal*, **2**, 976.

Jones, R. S., Buston, M. H., and Wharton, M. J. (1962). The effect of exercise on ventilatory function in the child with asthma. *British Journal of Diseases of the Chest*, **56**, 78.

König, P., Abramov, A., and Godfrey, S. (1971). Exercise-induced asthma as an objective criterion for assessing response to disodium cromoglycate. (Hebrew.) *Harefuah*, **81**, 127.

Williams, H., and McNicol, K. N. (1969). Prevalence, natural history, and relationship of wheezy bronchitis and asthma in children: an epidemiological study. *British Medical Journal*, **4**, 321.


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