Exercise-induced asthma and cardiovascular fitness in asthmatic children

B J Thio, A F Nagelkerke, A G Ketel, B L van Keeken, J E Dankert-Roelse

Abstract

Background – The role of physical training in the management of children with exercise-induced asthma is controversial. A study was undertaken to determine whether a relationship could be found between the occurrence of exercise-induced asthma and the degree of cardiovascular fitness in asthmatic children.

Methods – Twenty eight children aged 6–13 with mild to moderate asthma and dyspnoea during or after physical exercise were tested. All patients had a basal forced expiratory volume in one second (FEV₁) of >80% predicted. Twelve patients were taking corticosteroid maintenance medication by inhalation and 16 were not. Two exercise tests were performed on a treadmill to assess peak oxygen consumption rate (\(V_{O2}\max\)) and the percentage decrease in FEV₁ after exercise.

Results – There was no correlation between the \(V_{O2}\max\) and the percentage decrease in FEV₁. Patients not taking steroids showed a greater fall in FEV₁ than those receiving corticosteroid medication (mean fall in FEV₁: 28-7% versus 6-6%). Four of the 12 children treated with steroids and two of the 16 children not taking steroids had a level of cardiovascular fitness lower than the 5th percentile for healthy Dutch children.

Conclusion – Normal cardiovascular fitness does not prevent exercise-induced asthma.

\(V_{O2}\max\) test

The \(V_{O2}\max\) test was performed on a treadmill (Quinton Q45) using a modified Bruce protocol to reduce the steps. The speed and inclination were increased by half the step of the Bruce protocol every 1.5 minutes rather than every three minutes. One actuation of a salbutamol 200 \(\mu g\) metered dose pressurised aerosol (Ventolin) was administered by a large volume spacer (Volumatic) 15 minutes before each exercise test. The use of salbutamol does not affect \(V_{O2}\max\). Minute ventilation and mixed expired concentrations of carbon dioxide and oxygen were measured continuously by a verified Mynhardt Oxycon (OX4) to allow calculation of oxygen consumption (\(V_{O2}\) in \(l/\min\)), carbon dioxide production (\(V_{CO2}\) in \(l/\min\)), and the respiratory quotient (R). Heart rate was measured with a Polar Sport tester. \(V_{O2}\max\) was assumed to be reached when two of the following three criteria were met: (1) the respiratory quotient exceeded 1.0; (2) no further increase in heart rate occurred despite increasing load; and (3) no further increase in oxygen uptake occurred despite increasing load.
Exercise-induced asthma test
Inhaled bronchodilators were withheld for at least eight hours before the exercise-induced asthma test. Before the start of the exercise test on the treadmill the baseline value of the FEV₁ was obtained with a Sensor-Medics Pulmot...
rank correlation coefficient \((r)\) between percentage predicted \(V_O_2_{\text{max}}\) and percentage fall in \(F_EV_y\) was calculated. The percentage fall in \(F_EV_y\) of the children treated with steroids was compared with those who did not receive steroids using the Student’s \(t\) test.

**Results**

In 28 of the 31 children the criteria for a \(V_O_2_{\text{max}}\) were reached. There was no correlation between the % predicted \(V_O_2_{\text{max}}\) and the % fall in the \(F_EV_y\) in either the steroid treated children, \(r = -0.54 (-0.85/0.05)\), or those not receiving steroid treatment, \(r = 0.44 (-0.07/0.77)\) (figure).

The mean (SD) fall in \(F_EV_y\) in the steroid treated children was 6.6 (3.1)% and 28.7 (12.5)% in those who did not receive steroids (p<0.001). Four of the 12 children in the corticosteroid group and two of the 16 in the non-steroid group had a \(V_O_2_{\text{max}}\) lower than the 5th percentile for their age group (tables 1 and 2).

**Discussion**

Exercise-induced asthma and cardiovascular fitness were not related in either the steroid treated patients or those not taking steroids, which shows that children with severe exercise-induced asthma can attain normal cardiovascular fitness. Furthermore, it indicates that normal cardiovascular fitness in itself does not prevent severe exercise-induced asthma. Patients not on steroid treatment had more severe exercise-induced asthma than the steroid treated patients, which confirms the importance of inhaled steroids in the prevention of exercise-induced asthma. Inhaled corticosteroids reduce the severity of exercise-induced asthma substantially in a relatively short period compared with other indicators of airways responsiveness such as peak flow variability and bronchial responsiveness to methacholine. Most of the steroid treated children showed no substantial exercise-induced asthma. Their symptoms of exercise-induced dyspnoea were probably due to reduced cardiovascular fitness. To keep up with their peers they needed to make a greater effort which may explain their symptoms. We conclude that inhaled steroids are first line therapy for severe exercise-induced asthma. Physical training should be reserved for those children in whom a reduced cardiovascular fitness does not become normal while on treatment with inhaled steroids.

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