



ORIGINAL ARTICLE

Correlations Between Pulmonary Function and Childhood Asthma Control Test Results in 5–11-year-old Children with Asthma



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Key Words

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Control Test
(C-ACT);
forced expiratory
volume in the first
second (FEV₁);
lung function test;
maximal mid-
expiratory flow rate
(MMEF);

Objectives: We examined correlations between the two asthma assessment tools, pulmonary function tests, and Childhood Asthma Control Test (C-ACT) scores, in 5–11-year-old children with asthma to determine if the C-ACT scores could predict pulmonary function test results.

Materials and methods: A total of 172 children with asthma aged 5–11 years completed C-ACT questionnaires and underwent pulmonary function testing. Correlations between these test results were examined. Patients were also placed into two groups, C-ACT scores ≤ 19 and >19 , to determine if patients with scores >19 had better pulmonary function test results.

Results: Weak correlations were found between pulmonary function test results and childhood asthma control test scores in 5–11-year-old children with asthma, with or without the use of an asthma controller. These correlations included: 0.061 for FEV₁ [confidence interval (CI): -0.022 – 0.049] and 0.074 for MMEF (CI: -0.013 – 0.037). The proportions of children with C-ACT test scores ≤ 19 group and those with scores >19 group were not significantly different.

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pediatric;
pulmonary function;
spirometry

Conclusion: Correlations between C-ACT scores and pulmonary function test results were poor for children aged 5–11 years with asthma. FEV₁, FVC, FEF₂₅, FEF₅₀, FEF₇₅, MMEF, and PEFR were not significantly correlated with C-ACT scores.

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1. Introduction

Childhood asthma is a common chronic disease that can be fatal in critical conditions without timely treatment. In recent years, asthma treatment has emphasized both the severity of an attack and the degree of asthma control that can be achieved. The Childhood Asthma Control Test (C-ACT) is a widely used asthma control assessment tool that is recognized by the Global Initiative for Asthma (GINA). This assessment questionnaire was developed by Liu et al¹ in 2007 for children aged 4–11 years with asthma.

This questionnaire includes seven questions and is divided into two parts: the first four questions are self-administered by the child; the last three questions are answered by a caregiver on the basis of the child's condition during the previous 4 weeks. The total Asthma Control Test score is the sum of the answers given by the children and caregivers. Scores of ≥ 20 indicate good asthma control, whereas scores of ≤ 19 indicate inadequate asthma control in children. The results of this questionnaire were highly correlated with specialists' ratings of asthma control and the need for changes in patients' therapies ($p < 0.0001$).¹

Lung function tests are used for pediatric asthma patients to examine changes in lung volume and air flow during forced inspiration and expiration in order to determine the degree of airway obstruction. Pediatric patients must be older than 5 years of age to undergo a lung function test. The most commonly used parameters include peak expiratory flow rate (PEFR), forced vital capacity (FVC), forced expiratory volume in the first second (FEV₁), FEV₁/FVC ratio, forced expiratory flow at 25% of forced vital capacity (FEF₂₅), forced expiratory flow at 50% of forced vital capacity (FEF₅₀), forced expiratory flow at 75% of forced vital capacity (FEF₇₅), the ratio between forced expiratory flow between 25% and 75% of vital capacity (FEF_{25–75}), and the maximal mid-expiratory flow rate (MMEF), which indicates the average expiratory flow over the middle half of the forced vital capacity. FEF₂₅, FEF₅₀, FEF₇₅, FEF_{25–75}, and MMEF are useful for detecting small airway obstruction, and MMEF and FEF₅₀ are highly correlated.^{2,3}

In addition, currently used lung function devices also calculate the percentages of the predicted values for FEV₁, FEF₂₅, FEF₅₀, FEF₇₅, MMEF, FVC, and PEFR. For example, the percent predicted FEV₁ (FEV₁ % predicted) is defined as the patient's FEV₁ divided by the average FEV₁ in a population of similar age, sex, and body composition.

Clinically, the vast majority of children with asthma who receive long-term medication treatment do not present decreases in FEV₁ or FEV₁/FVC without an asthma attack; only abnormal decreases in FEF₂₅, FEF₅₀, FEF₇₅ or MMEF are

noted. These pulmonary function results indicate that the vast majority of children with asthma only have a small airway obstruction. The study by Liu et al¹ showed that C-ACT scores and FEV₁ % predicted values were weakly correlated ($p = 0.0494$). Previous studies investigated correlations between C-ACT scores and PEFR results.^{1,4,5} However, correlations between C-ACT scores and FEF₂₅, FEF₅₀, FEF₇₅, and MMEF have not been investigated.

Thus, in this study, we examined the correlations between two asthma assessment tools, pulmonary function test results for FEV₁, FVC, FEF₂₅, FEF₅₀, FEF₇₅, MMEF, and PEFR, and C-ACT scores. Our aim was to determine if C-ACT scores could predict the pulmonary function results for young asthma patients and to help clinicians have better understanding and control childhood asthma without acute attacks.

2. Materials and Methods

2.1. Study patients

This study was conducted from December 30, 2011 to December 29, 2012 in Changhua Christian Hospital, Changhua, Taiwan. The participants were 5–11-year-old patients with asthma who were undergoing routine clinic follow-ups and required pulmonary function tests. All patients had more than three asthma episodes that had been diagnosed by the same attending physician; the interval between diagnoses was more than 1 month. Some patients with a diagnosis of asthma were still using a controller (leukotriene antagonist or inhaled corticosteroid), whereas others were stable and had stopped using a controller.

We excluded patients with pulmonary or upper respiratory infections or those having acute asthma attacks. Patients who had taken theophylline, beta agonist within 1 day or steroid within 3 days, were also excluded from this study in order to avoid the effects of medication on the pulmonary function. We recorded and grouped patients by their current medication use; patients who were using an inhaled corticosteroid or a leukotriene antagonist (Singulair) were the controller group and patients who had stopped using these two medications were the non-controller group. This study was approved by the Institutional Review Board of Changhua Christian Hospital.

2.2. C-ACT questionnaires

We provided the C-ACT questionnaire 10 minutes prior to when a patient underwent pulmonary function testing. Primary information about the study was presented to both the relatives and the child by a respiratory therapist. Once

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