



## Letter

## Assessing asthma in African American children using the Asthma Control Test and the Childhood Asthma Control Test

African Americans disproportionately experience uncontrolled asthma.<sup>1</sup> Because asthma control is now the focus of asthma management,<sup>2</sup> publicly available questionnaires, such as the Asthma Control Test (ACT)<sup>3</sup> and the Childhood Asthma Control Test (C-ACT),<sup>4</sup> represent the most accessible, standardized, nonphysician methods of assessing control and are typically considered cost-effective and easily implemented asthma care strategies for primary care offices. Both the ACT (for those 12 years or older) and the C-ACT (for those younger than 12 years) query asthma symptoms during the past 4 weeks and use a cut point of 19 or less for not well-controlled asthma.<sup>3,4</sup> Because neither questionnaire has been validated in African American children,<sup>5–10</sup> we sought to determine whether the ACT and the C-ACT are appropriate screening tools for asthma control in this population.

This retrospective study was approved by the University of North Carolina Institutional Review Board. From a list maintained by an asthma educator for all pediatric patients with asthma seen at the pulmonology or allergy/immunology clinics, we reviewed the medical record and included data from all children who met the following inclusion criteria: self-identified as African American, aged 5 to 18 years, and had at least 2 visits for which ACT or C-ACT and spirometry were performed from January 1, 2011, through November 1, 2013. Fifty-seven children were identified. The primary author reviewed medical records from each visit and determined physician assessment of asthma control by physician's written explicit determination of control or, if this were not available, review of medication management strategies (classifying continuation of current management or de-escalation of therapy as well controlled and the escalation of therapy as not well controlled). Although investigators were not masked to spirometry and ACT or C-ACT scores, these values were, in most cases, collected by another investigator independent of medical record review for asthma control.

By this method, we collected a total of 130 observations or visits with 84 visits in 41 children 12 years or older (45 well-controlled asthma visits and 39 not well-controlled asthma visits by physician assessment) and 46 visits in 22 children younger than 12 years (24 well-controlled asthma visits and 22 not well-controlled asthma visits by physician assessment). The overall mean number of visits per each child in this study was 2.3. All visits of a child were included in the analyses, and multilevel

analysis was used to account for the correlation of the values within a child across visits. The Wilcoxon rank sum test was used to compare the ACT medians across categories of physician assessment of asthma control (controlled vs not controlled). We determined the agreement of the ACT score at the standard cut point of greater than 19 with physician assessment of control using measures of sensitivity, specificity, and Cohen  $\kappa$ . A receiver operating curve was used to determine the best ACT cut point for assessment of control in this population. A logistic regression model was used with control by physician as the dependent variable and ACT score as the independent variable. This model included as potential confounders forced expiratory volume in 1 second (FEV<sub>1</sub>) and FEV<sub>1</sub>/forced vital capacity (FVC) (dichotomized at 80%) and age of the child (<12 or ≥12 years of age) as a potential moderator of the effect of the ACT score. These models also included a random intercept effect for the child to account for the correlation among the repeated measures in a child.

Adolescents aged 12 to 18 years with controlled asthma by physician assessment had higher ACT scores than those without controlled asthma ( $P < .001$ ). An ACT score higher than 19 was strongly associated with physician assessment of control in this group (Fisher exact test  $P < .001$ ). However, this cut point provided only a sensitivity of 67% and a specificity of 82% in determining physician assessment of asthma control in this minority group. On further investigation, we were able to identify that a cut point of 18 demonstrated the highest area under the curve (area under the curve of 0.8256) in this group (Fig. 1) with a sensitivity of 74% and a specificity of 67%. Spirometry was important in predicting physician assessment of control, especially FEV<sub>1</sub>/FVC of 80% or higher ( $P = .03$ ). However, the ACT score did not agree with spirometry-measured control defined by FEV<sub>1</sub> greater than 80% ( $\kappa = 0.20$ ,  $P = .03$ ).

When reviewing the entire data set of children aged 5 to 18 years, logistic regression demonstrated that higher ACT scores are associated with increased odds of one's asthma being classified as controlled by physician assessment ( $P < .001$ ). However, older age (being ≥12 compared with <12 years old) significantly affects this association ( $P = .03$ ), and after adjusting for this effect, the ACT score was no longer a significant predictor of physician-assessed control ( $P = .64$ ). This age cut-off distinguished those children who self-administer the ACT (≥12 years old) from the caregiver-administered C-ACT (<12 years old). In children younger than 12 years, we saw no difference in the C-ACT scores between patients with controlled or not well-controlled asthma as determined by physician assessment ( $P = .10$ ). Using a standard cut point of greater than 19 for asthma control on the C-ACT was not associated with physician assessment of control (Fisher exact test  $P = .39$ ) and did not agree with spirometry-measured control defined

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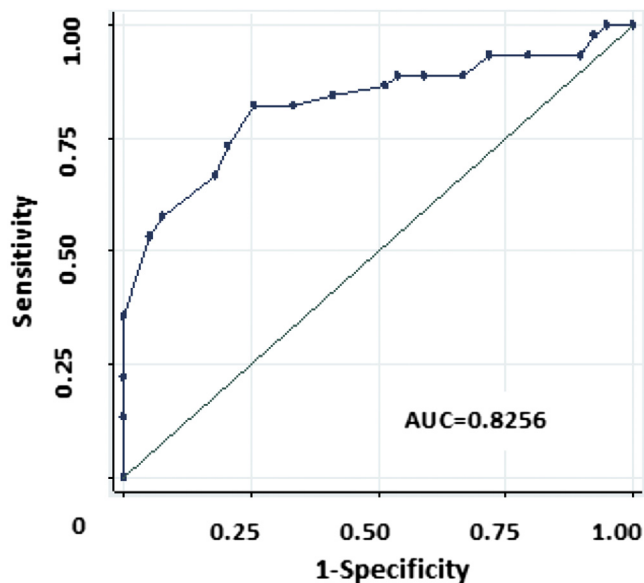


**Figure 1.** Receiver operating curve showing Asthma Control Test scores compared with physician control assessment in children 12 years or older. AUC indicates area under the curve.

by an FEV<sub>1</sub> greater than 80% ( $\kappa = 0.34$ ,  $P = .009$ ). In addition, a cut point of greater than 19 only had a sensitivity of 50% and a specificity of 64% in these younger children.

In this study, we demonstrate that the C-ACT as currently used may not accurately predict asthma control in African American children younger than 12 years, showing limited functionality in this group with low sensitivity and specificity for mirroring the criterion standard of physician assessment of asthma control. Surprisingly, this points to a clear discrepancy between caregiver and physician perception of asthma control in children younger than 12 years. Although the C-ACT queries both child and caregiver, greater weight is given to those caregiver-answered questions. Hence, failure of a caregiver to recognize not well-controlled asthma has implications for affecting asthma treatment plans and may also contribute to the increased risks of morbidity and mortality associated with uncontrolled asthma in this population.

Although the ACT had better performance in children 12 years or older (who do fill out their own questionnaires), we also found that sensitivity for determining asthma control could be increased by changing the ACT cut point to 18 rather than greater than 19 (with a previously reported sensitivity of 71.3% and specificity of 70.8% in a primarily white population<sup>6</sup>).

Limitations to our study include its retrospective nature, small sample size, unknown effect of socioeconomic status or the nature of the visit (scheduled vs urgent care), and possible investigator bias (nonmasking to ACT or C-ACT and spirometry results). Overall, our results suggest that current use of the ACT and C-ACT may require adjustment to better correlate with physician assessment of asthma control in African American children. Additional

prospective studies are required to further explore these findings and inform alternate clinical practice standards.

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