RESEARCH PAPER

Evaluation of Asthma Control in Children Using Childhood–Asthma Control Test (C-ACT) and Asthma Therapy Assessment Questionnaire (ATAQ)

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Objectives: To evaluate the efficacy of Childhood-asthma control test (C-ACT) and the Asthma therapy assessment questionnaire by (ATAQ) checking its consistency with Global Initiative for Asthma (GINA) criteria. **Method**: Asthma control of 97 children was assessed using C-ACT, ATAQ and GINA criteria separately, and their results were compared. **Result**: C-ACT had better performance for evaluating control as per GINA criteria with sensitivity of 48.3%, specificity of 68.9%, and area under the receiver operative curve (ROC) of 0.647. The above parameters for ATAQ were: 93.1%, 17.2% and 0.552, respectively. A cut-off score of 20 for C-ACT is more suitable as it has maximum ROC area (0.667), and higher kappa score (0.315); *P*= 0.001. **Conclusion**: C-ACT can be validity used to monitor asthma control. However, the cut-off score 20 is more accurate for the Indian population. The performance of ATAQ in evaluating asthma control is not satisfactory.

Keywords: *Asthma control, Pediatric asthma, Questionnaire assessment, Self-assessment*.

The goal of asthma care is to achieve and maintain control of symptoms for prolonged periods [1-3]. The Global initiative for asthma (GINA) offers a framework to do so through the GINA criteria, which requires the measurement of pulmonary functions [1]. As effective asthma care requires periodic assessment of asthma control, it is not feasible to perform pulmonary function tests (PFT) repeatedly in resource-poor settings. A quick screening method such as a questionnaire would reduce the need of repeated assessment by PFT. A commonly used questionnaire for the age group of 4-12 years is the childhood asthma control test (C-ACT), which includes questions directed to both caregiver and the child, formulated based on the observation that poor association exists poor co-relations between the symptom reports of parents and children [4,5]. Results of various studies conducted to validate C-ACT are mixed and conflicting [6-9]. Another questionnaire available is the asthma therapy assessment questionnaire (ATAQ) whose efficacy remains unclear.

The objective of this study was to determine the efficacy of these questionnaires for asthma control assessment.

METHODS

This cross-sectional validation study was conducted in the Department of Pediatrics M.S. Ramaiah Medical College and Hospitals, Bengaluru, India, over a period of six months (April 2014 to June 2014).The study sample consisted of 97 patients with clinically established bronchial asthma, belonging to the age group of 4-12 years, visiting or admitted to the hospital. Children with co-existing pulmonary anomalies, or other co-morbid conditions were excluded from the study.

Informed consent was obtained from the guardians of all the children. A complete history for the past 4 weeks of illness was taken. Each caregiver and child was asked to fill out the C-ACT and ATAQ questionnaires appropriately. Spirometry and Peak expiratory flow rate (PEFR) were performed and anthropometry was recorded. The child's asthma control status was independently determined by the GINA criteria and the questionnaires. As the GINA criteria divides asthma control status into three categories (controlled, partially controlled and uncontrolled), the category, partially controlled' was considered as controlled asthma' for the purpose of comparison of finding with the questionnaires [2].

Statistical analysis was carried out by SPSS software and Receiver operative curves (ROC) were generated using MedCalc software. Performance of C-ACT and ATAQ in evaluating asthma control in comparison with GINA criteria was analyzed with sensitivity, specificity, positive predictive value, negative predictive value,

kappa statistics and area under ROC. McNemor's test was used to compare the sensitivity of C-ACT and ATAQ. The above were calculated for each new cut-off score in comparison with GINA criteria to determine the most suitable cut-off score.

RESULTS

Among the 97 children (64 boys) included in the study, C-ACT, ATAQ and GINA criteria based evaluation showed that 62%, 10% and 33% of the children had controlled asthma.

Considering GINA criteria as the gold standard, the sensitivity, specificity positive predictive value and negative predictive value for the C-ACT and ATAQ are represented in ***Table* I**. The kappa statistics provided a kappa value of 0.1865 and 0.255 for agreement of ATAQ and C-ACT with GINA criteria respectively. The performance of C-ACT was better than that of ATAQ (difference of 42.5%, $P<0.001$).

The diagnostic performance of C-ACT for cut-off scores 17, 18, 19, 20 and 21 is presented in ***Table* II**. When a ROC curve was generated for the C-ACT in comparison to the GINA criteria, the automatically generated statistically best cut-off was found to be 20 with the area under the curve of 0.706 at significance level of 0.0003 as (***Fig.* 1**).

DISCUSSION

The present study suggests that C-ACT is a fairly valid tool for evaluating asthma control in children, with best performance at a cut-off of 20. ATAQ, on the other hand, seems to have unsatisfactory performance in evaluating control of asthma in our setting.

The major limitations of the study were language barrier, and varied education level and socioeconomic stata of the caregivers; these factors may play a role in determining the quality of responses. A single center - based enrolment and small sample size were the other limitations.

Although the current study shows that C-ACT is a fairly valid tool, the results of this study are not as favorable as the studies conducted in other geographic regions [6-9]. While the sensitivity of C-ACT was found to be higher then that reported by Koolen, *et al*. [7] Chalise, *et al.* [10] have demonstrated higher sensitivity. Our study showed that the cut-off score of 20 is more suitable; in a study conducted in California also suggested need for a different cut-off for Hispanic children [10]. Performance of ATAQ was found to be less satisfactory in the present study, which is in contrast to the findings of the study by Skinner, *et al*. [11].

We conclude that the C-ACT questionnaire is in fair agreement with GINA criteria, and has satisfactory performance in evaluation of asthma control. However, the current standard cut-off score of 19 tends to underestimate asthma control and a cut-off score of 20 may be better.

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TABLE I COMPARATIVE PERFORMANCE OF C-ACT AND ATAQ

Parameter	*C-ACT*	*ATAQ*
Specificity	69.0%	17.2%
Sensitivity	48.3%	93.1%
Positive predictive value	78.5%	69.2%
Negative predictive value	44.4%	55.6%
Area under ROC curve	0.647	0.552
At significance level of	0.0061	0.1897

C-ACT: Childhood asthma control test; ATAQ: Asthma; therapy assessment questionnaire; ROC: Receiver operator curve.

TABLE II PERFORMANCE OF C-ACT AT DIFFERENT CUT-OFF SCORES

	Cut-off Score for C-ACT				
Parameter	*19 (standard)*	*17*	*18*	*20*	*21*
Specificity	69.0%	93.1%	82.8%	58.6%	27.6%
Sensitivity	48.3%	34.5%	47.4%	74.1%	86.2%
Positive predictive value	78.6%	90.9%	84.9%	78.2%	70.4%
Negative predictive value	44.4%	41.5%	44.4%	53.1%	50%
P value	0.05	<0.001	<0.001	0.0003	0.0259
Kappa	0.255	0.210	0.255	0.319	0.659
Area under the ROC curve	0.647	0.638	0.655	0.664	0.569

C-ACT: Childhood asthma control test; ROC: Receiver operator curve.

WHAT THIS STUDY ADDS?

- C-ACT is a satisfactory tool for measurement of asthma control. The cut-off score of 20 seems to be a more suitable for the Indian population.
- ATAQ has unsatisfactory performance as an independent tool for asthma control.

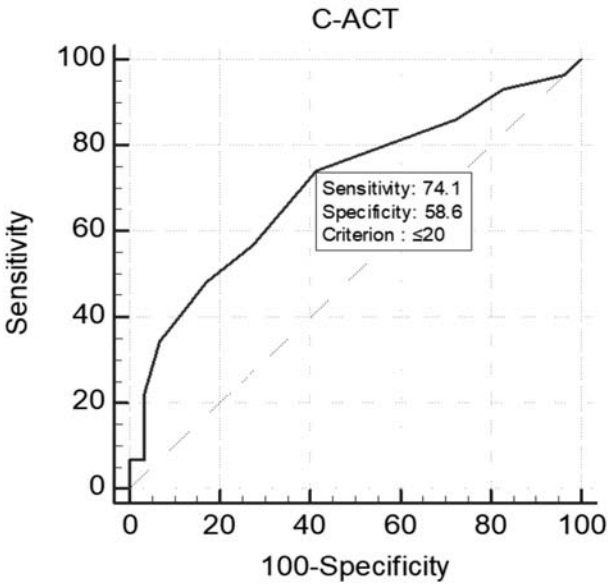

FIG. 1 *Composite ROC curve for diagnostic performance of C-ACT in evaluating asthma control.*

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