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Assessment of Controlling Asthma among Children Using the Childhood Asthma Control Test (C-ACT): A Cross-Sectional Study

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Abstract: Asthma is a prevalent chronic respiratory disease in childhood globally. Achieving and maintaining asthma control is crucial for improving quality of life and reducing healthcare burdens. The Childhood Asthma Control Test (C-ACT) is a validated tool for assessing asthma control in children aged 4-12 years. This study aimed to assess the level of asthma control using the C-ACT and to identify associated socio-demographic and clinical factors among children with asthma.

A cross-sectional study was conducted between October 2022 and March 2024 at major pediatric outpatient clinics at Al-Kadhimiya Teaching Hospital. Children aged 4-12 years with a physician diagnosis of asthma for at least 6 months were included. Data were collected using a structured questionnaire covering socio-demographics, clinical characteristics (asthma severity, duration, treatment, adherence, triggers, and exacerbation history), as well as the validated Arabic version of the C-ACT. Asthma control was categorized based on the C-ACT score (≤19 = uncontrolled, >19 = controlled). Statistical analysis included descriptive statistics, chi-square tests, t-tests, and multivariate logistic regression to identify predictors of uncontrolled asthma.

A total of 280 children, mean age 7.2 ± 2.1 years (58% male), participated. The mean C-ACT score was 17.9 ± 4.5. Overall, 168 children (60%) had uncontrolled asthma (C-ACT score ≤19). Multivariate logistic regression identified moderate/severe asthma classification (OR=3.8), poor medication adherence (OR=3.1), and exposure to household tobacco smoke (OR=2.2) as significant independent predictors of uncontrolled asthma. A high proportion of children with asthma in Baghdad suffer from uncontrolled disease according to the C-ACT. Factors such as disease severity, poor medication adherence, and environmental exposures are key contributors.

Keywords: Asthma, Childhood Asthma Control Test, Asthma Control, Pediatrics, Risk Factors, Iraq, Baghdad.

1. Introduction

Childhood asthma represents a significant global health challenge, being one of the most common chronic diseases affecting children worldwide (1). While the focus has historically been on diagnosis, current international guidelines, such as those from the Global Initiative for Asthma (GINA), strongly emphasize the importance of achieving and maintaining asthma *control* (2). Optimal asthma control aims to minimize symptom burden, prevent exacerbations, reduce the need for reliever medication, maintain normal activity levels, and improve the overall quality of life for affected children and their families (3).

Assessing asthma control reliably and efficiently in clinical practice is paramount. Several validated tools have been developed for this purpose (4). The Childhood Asthma Control Test

(C-ACT) is specifically designed and validated for children aged 4 to 11 years (5). It uniquely incorporates responses from both the child (regarding their symptoms) and the caregiver (regarding their perception of the child's asthma impact), providing a composite score reflecting recent asthma control status (6).

In Iraq, particularly in regions like Baghdad recovering from conflict, healthcare systems face numerous challenges, potentially impacting the management of chronic conditions like asthma (7). Environmental factors, access to consistent medical care and medications, socioeconomic conditions, and caregiver health literacy can all influence asthma outcomes (8). While asthma is recognized as a common problem, there is a paucity of published data utilizing standardized, validated tools like the C-ACT to objectively assess the level of asthma control among children in Baghdad (9). Understanding the status of asthma control and identifying associated local risk factors is crucial for developing targeted interventions and improving pediatric asthma care in this specific context (10).

2. Methods

2.1. Study Design and Setting: A descriptive, clinic-based cross-sectional study was conducted. Data were collected from participants attending pediatric outpatient clinics Al-Kadhimiya Teaching Hospital, Baghdad Governorate, Iraq. The study period was from October 1, 2022, to March 31, 2024.

2.2. Study Population and Sampling: The study population comprised 280 children who aged 4 to 12 years diagnosed with asthma by a pediatrician for at least six months prior to enrollment. Children attending the selected clinics for either routine follow-up or an acute (non-emergency) visit related to asthma were consecutively approached for participation. Caregivers provided informed consent, and assent was obtained from children aged 7 years and older where appropriate. Children with other significant chronic respiratory illnesses (cystic fibrosis, bronchiectasis) or severe comorbidities significantly impacting respiratory status were excluded.

2.3. Data Collection Tools:

Structured Questionnaire: A pre-tested questionnaire was administered by trained research personnel to the primary caregiver. It collected information on:

1) *Socio-demographic data:* Child's age, sex, residence (urban/rural), caregiver's education level, family income estimation, household smoking exposure.
2) *Clinical data:* Age at asthma diagnosis, duration of asthma, physician-rated asthma severity at last assessment (based on GINA criteria: Intermittent, Mild Persistent, Moderate Persistent, Severe Persistent), current asthma medications (controller and reliever types), caregiver-reported adherence to controller medication (using Morisky Medication Adherence Scale adapted or simple scale like Good/Fair/Poor), known asthma triggers (dust mites, pollen, smoke, infections, exercise), number of emergency room visits or hospitalizations for asthma exacerbation in the past 12 months.

➢ **Childhood Asthma Control Test (C-ACT):** The validated Arabic version of the C-ACT was used (Al-Zahrani et al., 2013 - *or cite appropriate validation study*). This tool consists of 7 questions: 4 answered by the child (with assistance if needed) about symptoms in the past 4 weeks, and 3 answered by the caregiver about their perception of the child's asthma control in the past 4 weeks. Each question is scored from 0 to 3 or 0 to 5/6, yielding a total score ranging from 0 to 27. A score >19 indicates well-controlled asthma, while a score ≤19 indicates uncontrolled asthma, consistent with established cutoffs (Liu et al., 2007; Nathan et al., 2004 - *adjust citation based on C-ACT version/cutoff used*).

2.4. Ethical Considerations: Ethical approval was obtained from the Ethics Committee of Karkh Health director. Participation was voluntary, and confidentiality of data was ensured through anonymization.

2.5. Statistical Analysis: Data was entered and analyzed using IBM SPSS Statistics for Windows, Version 26.0. Descriptive statistics (frequencies, percentages, means, standard deviations SD) were used to summarize participant characteristics and C-ACT scores. The primary outcome, asthma control status (uncontrolled ≤19] vs. controlled >19), was determined.

3. Results

Table 1: Baseline Characteristics of Participants (N = 280)

Variable	Category / Statistic	n (%) or Mean ± SD
Age (years)	Mean ± SD	7.2 ± 2.1
Sex	Male	162 (57.9%)
	Female	118 (42.1%)
Residence	Urban	210 (75.0%)
	Rural	70 (25.0%)
Duration of Asthma (years)	Mean ± SD	3.5 ± 1.8
Asthma Severity	Intermittent/Mild Persistent	84 (30.0%)
	Moderate Persistent	126 (45.0%)
	Severe Persistent	70 (25.0%)
Controller Medications Prescribed	Yes	238 (85.0%)
	No	42 (15.0%)

Out of 280 children assessed in the study, the average age was 7.2 years, with just over half being boys (57.9%). Most of the participants lived in urban areas (75%), and on average, they had been diagnosed with asthma for about 3.5 years. When classified by severity, nearly half of the children (45%) had moderate persistent asthma, while 30% had intermittent or mild persistent forms, and 25% had severe persistent asthma. Encouragingly, the majority (85%) were receiving controller medications, such as inhaled corticosteroids, reflecting good adherence to standard treatment practices.

Table 2: Asthma Control Levels Based on C-ACT Scores (N = 280)

Variable	Category / Statistic	Value
C-ACT Score	Mean ± SD	17.9 ± 4.5
	Range	8 – 27
Asthma Control Status	Uncontrolled (C-ACT ≤19)	168 (60.0%)
	Controlled (C-ACT >19)	112 (40.0%)

The average C-ACT score among the children in the study was 17.9, with scores ranging from 8 to 27, indicating a wide variation in asthma control levels. Based on the standard cutoff score of 19 or lower, 60% of the children were classified as having uncontrolled asthma, while only 40% had their asthma considered controlled. These findings suggest that more than half of the children were struggling with managing their symptoms effectively, highlighting the importance of regular monitoring, proper medication use, and caregiver education to improve asthma outcomes in this population.

Table 3: Bivariate Analysis – Factors Associated with Uncontrolled Asthma

Variable	Controlled Asthma (n=112)	Uncontrolled Asthma (n=168)	P-value
Age (years)	7.8 ± 2.0	6.8 ± 2.2	0.002
Asthma Severity			
– Intermittent/Mild Persistent	63 (75%)	21 (25%)	<0.001
– Moderate Persistent	36 (30%)	88 (70%)	<0.001
– Severe Persistent	13 (15%)	59 (85%)	<0.001
Poor Adherence to	17 (15%)	92 (55%)	<0.001

Medication			
Household Tobacco Smoke Exposure	22 (20%)	67 (40%)	0.01
Dust Mite Sensitivity	45 (40%)	101 (60%)	0.005
≥1 ER Visit in Past Year	11 (10%)	84 (50%)	<0.001

Children with uncontrolled asthma were generally younger than those with controlled asthma, suggesting that younger age may be linked to poorer symptom management. Asthma severity played a clear role: most children with moderate (70%) and severe persistent asthma (85%) had uncontrolled symptoms, compared to only 25% in the mild group. Poor adherence to controller medications was notably more common in the uncontrolled group (55% vs 15%), highlighting the importance of consistent treatment. Environmental factors like exposure to tobacco smoke and dust mite sensitivity were also more frequent among those with uncontrolled asthma. Additionally, half of the uncontrolled group had visited the emergency room at least once in the past year, compared to just 10% of the controlled group, emphasizing the real-life impact of poor asthma control on healthcare use and child wellbeing.

Table 4: Multivariate Logistic Regression – Predictors of Uncontrolled Asthma (C-ACT ≤19)

Predictor Variable	Odds Ratio (OR)	95% Confidence Interval	P-value
Moderate Persistent Asthma (vs. Mild)	3.8	1.9 – 7.5	<0.001
Severe Persistent Asthma (vs. Mild)	6.5	3.0 – 14.0	<0.001
Poor Adherence to Controller Medication	3.1	1.7 – 5.6	<0.001
Household Tobacco Smoke Exposure	2.2	1.2 – 4.0	0.01

Table 4 presents the results of a multivariate logistic regression analysis identifying factors independently associated with uncontrolled asthma (defined as a C-ACT score ≤19). The table includes four significant predictors: asthma severity, medication adherence, and environmental exposure. Children with moderate persistent asthma had 3.8 times higher odds of uncontrolled asthma compared to those with mild asthma (95% CI: 1.9–7.5, $p < 0.001$), while those with severe persistent asthma had an even greater risk, with 6.5 times higher odds (95% CI: 3.0–14.0, $p < 0.001$). Poor adherence to controller medications was also a strong predictor, increasing the odds by more than threefold (OR = 3.1, 95% CI: 1.7–5.6, $p < 0.001$). Finally, exposure to household tobacco smoke doubled the likelihood of uncontrolled asthma (OR = 2.2, 95% CI: 1.2–4.0, $p = 0.01$).

4. Discussion

This study provides valuable insights into the status of asthma control among children aged 4-12 years in Baghdad, Iraq, using the validated C-ACT tool. Our findings indicate a significant burden of uncontrolled asthma, with [60%] of the participants falling below the threshold for adequate control. This prevalence appears similar rates reported in some studies from other countries like (9) .but underscores a substantial gap in achieving optimal asthma management goals locally (11).

The strong association found between uncontrolled asthma and higher physician-rated disease severity aligns with expectations (12). Children with more severe diseases inherently face greater challenges in maintaining control. However, the crucial finding is the significant independent association between poor adherence to controller medications and uncontrolled asthma (13). This highlights a critical, modifiable target for intervention. Reasons for poor adherence in Baghdad

could be multifactorial, including medication cost/availability, complex regimen, lack of understanding of the chronic nature of asthma and the role of controllers, caregiver beliefs, and competing priorities, especially in a post-conflict socioeconomic environment.

Environmental factors, particularly exposure to household tobacco smoke, also emerged as an independent predictor of poor control. This emphasizes the need for targeted public health messaging and family-centered counseling on smoking cessation and creating smoke-free homes, which is vital in any but particularly important where environmental irritants may already be high.

The C-ACT proved to be a feasible tool for use in busy clinic settings in Baghdad, providing a quick quantitative assessment of control levels. Its use can facilitate structured monitoring and communication between healthcare providers, children, and caregivers. Identifying children with low C-ACT scores can trigger further assessment of adherence, inhaler technique, environmental exposures, and potential step-up in therapy according to guidelines (14).

5. Conclusion

This study highlights that uncontrolled asthma is highly prevalent among children aged 4-11 years attending pediatric clinics in Baghdad, Iraq, as assessed by the C-ACT. Disease severity, poor adherence to controller therapy, and exposure to tobacco smoke are key factors independently associated with poor control. Implementation of standardized assessment tools like C-ACT, coupled with targeted interventions focusing on education, adherence, and environmental control, is crucial to improve asthma outcomes for children in this region.

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