

## Evaluation of Asthma Control Assessment in School-Age Asthmatic Children

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**Received:** 28 May 2022; **Accepted:** 01 Jul 2022; **Published:** 05 Jul 2022

**Citation:** Talha SAAM, Magzoub Alhaj OS, Elhag A, et al. Evaluation of Asthma Control Assessment in School-Age Asthmatic Children. J Med - Clin Res & Rev. 2022; 6(7): 1-6.

### ABSTRACT

*Asthma is the most common chronic disease among children. Some 235 million people worldwide suffer from this non-communicable disease but effective medicines are available that can control it. Asthma is said to be under-estimated and under diagnosed in tropical countries including Sudan. Several tools are useful for detecting uncontrolled asthma in children; however, childhood asthma control test is a validated tool for assessing asthma control in pediatric asthma.*

*A cross sectional study conducted over a period of six months (March 2016- September 2016) covering all school age asthmatic children attending the Asthma Clinic in Ahmed Gassim Children Specialized Hospital and Mohammed Elamin Hamid Pediatric Hospital during the period of study. The aim of this study is to assess asthma control in school age asthmatic children at Khartoum using childhood asthma control test (C- ACT) and peak flow meter (PEFR) and to detect associated factors with impaired asthma control.*

**Result:** A total of (84) asthmatics children most of them on prophylactic medications, according to ACT were found to be controlled 35 (41.7%), partially controlled 26 (22.2%) and uncontrolled 27 (32.1%). The main triggers as in other countries are infections, environmental factors and exercise.

**Conclusion:** In this study, we realized that none of the children of study group underwent any PEFr measurement in their asthma follow up and none of them has been assessed with ACT before. There was a high percentage of partially controlled and uncontrolled asthma in the selected group.

### Keywords

Asthma Control, School Children.

### Introduction

Asthma is the most common chronic disease among children. Some 235 million people worldwide suffer from this non communicable

disease but effective medicines are available that can control it. Asthma is said to be under-estimated and under diagnosed in tropical countries including Sudan [1]. There are 2 common types of childhood asthma based on different natural courses: (1) recurrent wheezing in early childhood, primarily triggered by common respiratory viral infections, usually resolves during the preschool/

lower school years; and (2) chronic asthma associated with allergy that persists into later childhood and often adulthood. School-age children with mild-moderate persistent asthma generally improve as teenagers with some (40%) developing intermittent disease.

Intermittent dry coughing and expiratory wheezing are the most common chronic symptoms of asthma. Older children and adults report associated shortness of breath and chest congestion and tightness; younger children are more likely to report intermittent, non-focal chest pain. Respiratory symptoms can be worse at night, associated with sleep disturbance, especially during prolonged exacerbations triggered by respiratory infections or inhalant allergens [2]. Daytime symptoms, often linked with physical activities (exercise-induced), are reported with greatest frequency in children.

Forced expiratory airflow measures are helpful in diagnosing and monitoring asthma and in assessing efficacy of therapy. Spirometry is a helpful objective measure of airflow limitation. Spirometry is an essential assessment tool in children who are at risk for severe asthma exacerbations and those who have poor perception of asthma symptoms. Valid spirometric measures depend on a patient's ability to properly perform a full, forceful, and prolonged expiratory maneuver, usually feasible in children > 6 year of age (with some younger exceptions) [2].

Measuring exhaled nitric oxide (FENO), a marker of airway inflammation in allergy-associated asthma, may possibly help adjust anti-inflammatory management and confirm the diagnosis of asthma [2]. Peak expiratory flow (PEF) monitoring devices provide simple and inexpensive home-use tools to measure airflow and can be helpful in a number of circumstances. Similarly, to spirometry in clinics, poor perceivers of asthma can benefit by monitoring PEFs at home to assess their airflow as an indicator of asthma control or problems [3]. The flow-volume curve is a graphic representation of individual forced expiratory maneuvers. It is included in most spirometry reports; only the expiratory limb is typically displayed. Obstructive defects are portrayed by scooping of the descending limb of the curve, a change that can be easily detecting by the experienced observer [4].

The C-ACT consists of seven items, addresses the previous 4 weeks and is divided into two parts. One part is filled in by the child and consists of four questions on perception of Asthma control, limitation of activities, coughing and awakenings at night. Each question has four response options. The Second part is filled in by the parent or caregiver and consists of three questions (daytime complaints, daytime wheezing and Awakenings at night) with six response options. The sum of all Scores yields the C-ACT score, ranging from 0 (poorest asthma Control) to 27 (optimal asthma control). A cut-off point f19 Indicates uncontrolled asthma detecting by the experienced observer [3]. Asthma Control Test ACT is a patient-completed questionnaire and consists of five items evaluating the preceding 4 weeks (limitation of Activities, shortness of breath, awakenings at night, use of Reliever medication and patient's perception of asthma control) [5,6]. Each question has five response options, resulting in Scores of 1–5. The sum of all scores yields the total ACT score, Ranging from

5 (poorest asthma control) to 25 (optimal asthma control). It has been validated from the age of 12 years and a Score f19 indicates poorly controlled asthma.

Diary cards contained questions on daytime symptoms, nocturnal Symptoms, limitation of activity and use of rescue medication. Daytime symptoms such as coughing, wheezing and shortness of breath were scored on a scale from 0 (no complaints) to 3 (Complaints during most of the day). In the same way, nocturnal symptoms such as coughing, wheezing and shortness of breath were scored from 0 (no complaints) to 3 (hardly any sleep due to respiratory symptoms). Limitation of activity Ranged from 0 (no limitations) to 3 (severe limitation of Activities) as well. Children and/or their parents could report the use of rescue medication as extra puffs taken. Access to the web-based diary was granted by a personal account with username and password. After logging in to the secured internet page, participants could answer the questions by clicking the appropriate box. After finishing the questions for a single day, results were submitted. Control status in any week was assessed according to GINA Criteria. An overall score was determined after 4 weeks, being the worst score of control status in any week. 5 completed Diary days in 1 week was considered the minimum to include the week's data in the final assessment of asthma control.

## Methodology and Results

A cross sectional study conducted over a period of six months (March 2016- September 2016) covering all school age asthmatic children attending the Asthma Clinic in Ahmed Gassim Children's Specialized Hospital and Mohammed Elamin Hamid Pediatric Hospital during the period of study. Total of (84) asthmatics children were included in the study. 43 (51.2%) were aged between 6-10 years and the others 41(48.8%) aged between 11-16 years. Males were found to be 50 (59.5%), while females were 34 (40.5%). Male to female ratio was 1.5:1 (Figure 1). The majority 79 (94%) are from Khartoum State and only 5 (6%) from outside Khartoum State (Figure 2). 28 (33.3%) of fathers of the studied children have secondary level of education while 15 (17.9%) of them were illiterates (Figure 3).

Duration of asthma for less than 5 years was reported in 36 (42.9%) of the asthmatic children and 11-15 years in 14 (16.7%) (Figure 4). Types of asthma reported in the studied children were mild intermittent 43 (51.2%), mild persistent 24 (28.6%), severe persistent 9 (13%) and moderate persistent 5 (7.2%) (Figure 5). According to ACT questionnaire the studied children were classified to controlled 35 (41.7%), partially controlled 22 (26.2%) and uncontrolled 27 (32.1%) (Figure 6).

The most common triggers of asthma reported among the studied children were house dust 20 (23.8%) and infections 19 (22.6%) (Table1). It is clear that 24 (54.5%) of the asthmatic children on prophylactic drugs categorized as asthma controlled while 17 (42.5%) of the children not on prophylactic drugs were uncontrolled (Table 2).

Significant differences were found among the studied children when correlating the types of prophylactic drugs with asthma control (Table 3). Controlled children who adhered to medications were 16 (36.8%) and uncontrolled who not adhered to medications were 8 (18.2%) indicates significant differences (Table 4). Among the studied children (either themselves or their parents learned the technique of using inhaler) 22 (50%) categorized as controlled compared to only 2 (4.5%) who were not learned. This indicates significant differences (Table 5).

Among controlled children 16 (19%) attained very good school performance while 7 (8.3%) attained poor performance, which is significantly different (Table 6). Distributions of the educational levels of the mother within controlled children was 15 (17.9%) secondary education, 12 (14.3%) university education, 9 (10.7%) primary school education and 3 (3.6%) illiterates. Significant association is found between mother's education and asthma control among the studied children (Table 7). With reference to family history of asthma; controlled children were found to be more common among families with history of asthma than those without history 19 (22.6%) versus 16 (19%), which indicates significant differences (Table 8). No significant association between asthma control and BMI of the child in this study (Table 9).

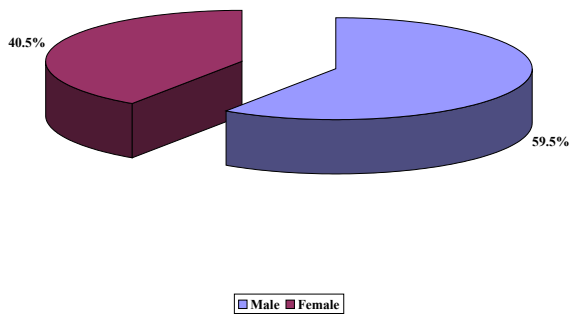


Figure 1: Distribution of the Asthmatic Children According To Gender.

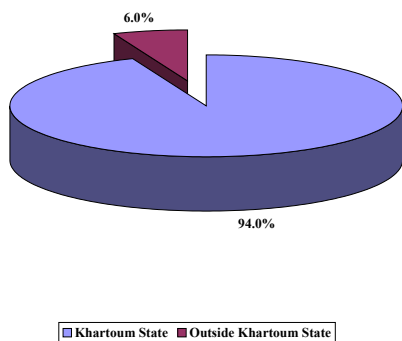


Figure 2: Distribution of the Asthmatic Children According Residence.

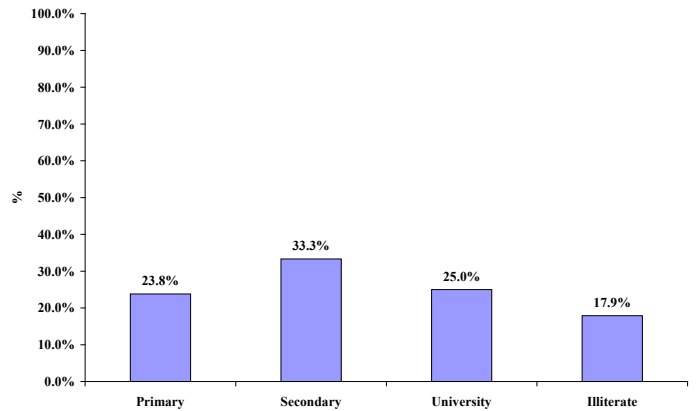


Figure 3: Distribution of the Asthmatic Children According To Education of the Father.

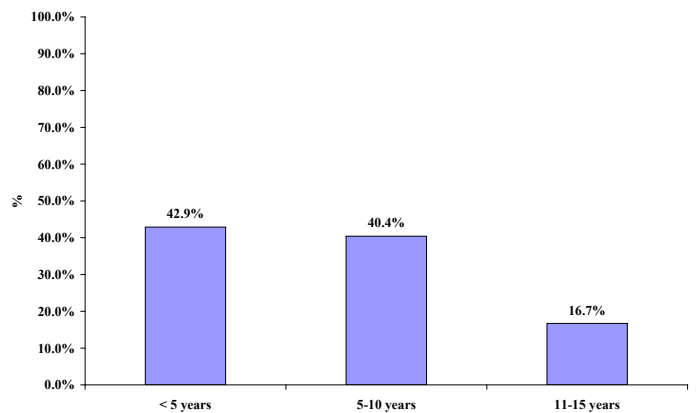


Figure 4: Distribution of the Asthmatic Children According To Age of Diagnosis with Asthma.

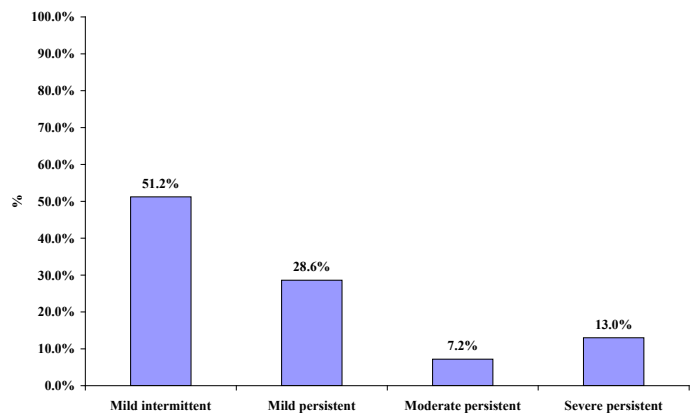
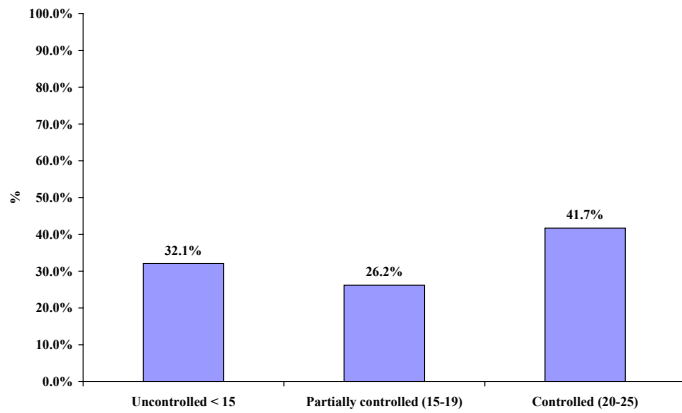


Figure 5: Distribution of the Asthmatic Children According To Type of Asthma.



**Figure 6:** Distribution of the Asthmatic Children According To Asthma Control (Using Act).

**Table 1:** Distribution of the Asthmatic Children According to Asthma Triggers.

Triggers	N	%
Nothing	2	2.4
Exercise	14	16.7
Passive smoking	12	14.3
House dust	20	23.8
Viral Infection	19	22.6
Plants and animals	6	7.1
Perfumes	6	7.1
Unknown	3	3.6
Rains	1	1.2
Winter	1	1.2
Total	84	100.0

**Table 2:** Distribution of the Asthmatic Children According to Asthma Control in Relation to Use of Prophylaxis.

Asthma control	On prophylactic drugs				P value
	Yes		No		
	N	%	N	%	
Uncontrolled < 15	10	22.7	17	42.5	0.012
Partially controlled (15-19)	10	22.7	12	30.0	
Controlled (20-25)	24	54.5	11	27.5	

**Table 3:** Distribution of the Asthmatic Children According to Asthma Control in Relation to Type of Prophylactic Drugs.

Types	Asthma control						P value
	Uncontrolled < 15		Partially controlled (15-19)		Controlled (20-25)		
	N	%	N	%	N	%	
LRA	0	0.0	0	0.0	2	4.5	0.01
Steroid inhaler	8	18.2	5	11.4	19	43.2	
Steroid + long acting beta agonist	1	2.3	0	0.0	0	0.0	
LRA + Steroid inhaler	1	2.3	5	11.4	3	6.8	

**Table 4:** Distribution of the Asthmatic Children According to Asthma Control in Relation to Adherence to Mediations.

Asthma control	Adherence to medication				P value
	Yes		No		
	N	%	N	%	
Uncontrolled < 15	7	15.9	8	18.2	0.02
Partially controlled (15-19)	8	18.2	3	6.8	
Controlled (20-25)	16	36.4	2	4.5	

**Table 5:** Distribution of the Asthmatic Children According to Asthma Control in Relation to Correct Use of Inhalers.

Asthma control	Parents/patient self-learned the technique of using inhaler				P value
	Yes		No		
	N	%	N	%	
Uncontrolled < 15	10	22.7	0	0.0	0.03
Partially controlled (15-19)	10	22.7	0	0.0	
Controlled (20-25)	22	50.0	2	4.5	

**Table 6:** Distribution of the Asthmatic Children According to Asthma Control in Relation to School Performance.

Asthma control	School performance						P value
	Poor		Good		V. Good		
	N	%	N	%	N	%	
Uncontrolled < 15	9	10.7	8	9.5	10	11.9	0.01
Partially controlled (15-19)	8	9.5	8	9.5	6	7.1	
Controlled (20-25)	7	8.3	12	14.3	16	19.0	

**Table 7:** Distribution of the Asthmatic Children According to Asthma Control in Relation to Educational Level of the Mother.

Mother education	Asthma control						P Value
	Uncontrolled < 15		Partially controlled (15-19)		Controlled (20-25)		
	N	%	N	%	N	%	
Primary	5	6.0	8	9.5	9	10.7	0.03
Secondary	3	3.6	6	7.1	15	17.9	
University	4	4.8	4	4.8	12	14.3	
Illiterate	11	13.1	4	4.8	3	3.6	

**Table 8:** Distribution of the Asthmatic Children According to Asthma Control in Relation to Family History of Asthma.

Asthma control	Family history of asthma				P value
	Yes		No		
	N	%	N	%	
Uncontrolled < 15	18	21.4	9	10.7	0.021
Partially controlled (15-19)	13	15.5	9	10.7	
Controlled (20-25)	19	22.6	16	19.0	
Total	50	59.5	34	40.5	

**Table 9:** Distribution of the Asthmatic Children According to Asthma Control in Relation to BMI of the Child.

BMI	Asthma control						P value
	Uncontrolled < 15		Partially controlled (15-19)		Controlled (20-25)		
	N	%	N	%	N	%	
Under weight	24	28.6	16	19.0	26	31.0	0.062
Ideal	2	2.4	5	6.0	8	9.5	
Overweight	1	1.2	1	1.2	1	1.2	
Total	27	32.1	22	26.2	35	41.7	

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## Discussion

Asthma is said to be under-estimated and under diagnosed in tropical countries including Sudan. Sudan is one of the countries using the Asthma Drug Facility (ADF) to improve asthma care. ISAAC [1] phases 3 (in Africa) have demonstrated for the first time that asthma is an emerging public health problem in Africa.

In this study, 84 school age children were investigated to compare between asthmatic children who use prophylactic drugs and those who do not. Forty-three of the studied asthmatic children (51.2%) aged between 5-10 years and the others 41(48.8%) aged between 11-16 years. Male to female ratio was 1.5:1[1].

In our study, the most common triggers of asthma reported among the studied children were house dust 20 (23.8%) and infections 19 (22.6%), which is similar to Study by Global Asthma Report 2011 revealed that asthma is the ninth of the most common disease among the school children, prevalence of 9, 2 and 17, 9%, the main trigger factors of which are dust, cold, exercise and smoke respectively [7].

We found that and According to ACT questionnaire the studied children classified to be controlled 35 (41.7%), partially controlled 22 (26.2%) and uncontrolled 27 (32.1%), which is similar to a study in Lebanon which showed that summed scores discriminated between groups of patients rating of asthma control ( $F=36.89$ ); the need for change in patient's therapy ( $F=20.07$ ) and % predicted FEV1 ( $F=2,66$ ) [8].

With reference to family history of asthma; controlled children were found to be more common among families with history of asthma than those without history 19 (22.6%) versus 16 (19%), which indicates significant differences ( $P < 0.05$ ). This is similar to a study in Lebanon showed significant association between Asthma control and family history of asthma [8]. In this study, significant association is found between mother's education and asthma control among the studied children ( $P = 0.012 < 0.05$ ), which indicates mothers with higher education more acknowledge about items of asthma control than mothers with lower education and these results similar to Lebanon study showed that the higher mother's level of education was significantly associated with more asthma control [9].

The types of asthma reported were mild intermittent 43 (51.2%), mild persistent 24 (28.6%), severe persistent 9 (13%) and moderate persistent 5 (7.2%), which is go in the same line with Swedish study showed that severe asthma was prevalent in 0.4% of children in a normal urban population at age 12, or 4% among children with asthma [10].

In our study, significant differences were found among the studied children when correlating the types of prophylactic drugs, adherence techniques used by caregivers/patients with asthma control ( $P = 0.01 < 0.05$ ). This is similar to study in Iran showed that the control and experimental groups Asthma control was significantly better in children on prophylactics [11].

There is significant association between asthma control and BMI of the child in this study, which is similar to Australian study showed a significant association between increased risk of worse asthma control and BMI. It was found to that poor asthma control significantly associated with poor school performance, the same as concluded by Australian study revealed that fewer children with controlled asthma reported missing 1 one or more school days in the previous week compared with children with inadequately controlled asthma [12].

## Conclusion

According to ACT questionnaire the studied children classified to controlled 35, partially controlled 22 and uncontrolled 27. Family history of asthma, BMI and mother education were found to be significantly associated with asthma control. In this study, the types of asthma reported were mild intermittent, mild persistent, severe persistent and moderate persistent. Significant differences were found among the studied children when correlating the types of prophylactic drugs, adherence techniques used by caregivers/patients with asthma control. Poor asthma control was found to be significantly associated with poor school performance.

## Recommendations

1. The study proves that the use of ACT, PEFr is beneficial for assessment of asthma control. Clinicians are urged to use these tools to monitor their asthmatic children.
2. Effective asthma management requires a preventative approach, with regularly scheduled visits during which symptoms are assessed, pulmonary function is monitored, medications are adjusted, and ongoing education is performed.
3. Patients should learn to monitor asthma control at home (e.g., frequency and severity of dyspnea, cough, chest tightness, and albuterol use).
4. Environmental triggers and co-existing conditions that interfere with asthma management should be identified and addressed for each patient.
5. Pharmacologic therapy varies according to asthma severity and asthma control. Asthma control is judged based on the current level of symptoms, FEV1 or PEFr values, and number of exacerbations.
6. At each return visit, the patient's asthma control is evaluated. If the asthma is not well controlled, therapy should be "stepped-up." If the asthma is well controlled, therapy can be continued or possibly "stepped-down" to minimize medication side effects.
7. Guidelines for when to refer a patient to a pulmonologist or an allergist/ immunologist are provided.

## Acknowledgment

The authors would like to thank Ahmed Gassim Children Specialized Hospital and Mohammed Elamin Hamid Pediatric Hospital (staff and administration) for their great help and support to produce this study.

## Statement of Informed Consent

Informed consent was obtained from all guardians of children included in the study.

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