RESEARCH ARTICLE

Asthma control status using Asthma Control Test (ACT) among intermediate school students in Baghdad 2024

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ABSTRACT

Introduction: Asthma is a prevalent non-communicable disease affecting millions globally. Adolescents experience a high prevalence and severity of asthma. The Asthma Control Test (ACT) is a validated tool to assess asthma control in children.

Objective: This study aimed to assess asthma control status among intermediate school students in Baghdad using the ACT and explore associated factors.

Methods: A cross-sectional study was conducted in Baghdad from March to April 2024. A multi-stage cluster sampling technique was used to select 2900 students from grade 2 of intermediate schools across six educational directorates. Data was collected through an online questionnaire. Asthma control status was categorized as controlled or uncontrolled based on ACT scores.

Results: Out of 264 students with asthma, 51% had controlled asthma and 49% had uncontrolled asthma. Uncontrolled asthma was significantly associated with several factors, including the use of inhaled medications (75% uncontrolled), the use of tablets, capsules, or other medications (64.1% uncontrolled), urgent doctor visits for breathing problems, emergency department visits, hospitalization, and school absenteeism.

Conclusion: This study identified a high prevalence of uncontrolled asthma among intermediate school students in Baghdad. Several factors were associated with uncontrolled asthma, including medication use, healthcare utilization, and school absenteeism. These findings highlight the need for targeted interventions to improve asthma control and reduce the burden of this disease among adolescents.

Key words: Asthma, adolescents, Asthma Control Test, uncontrolled asthma, Baghdad, school absenteeism, medication adherence.

INTRODUCTION

Asthma is a common global non-communicable disease that affects millions of children and adults worldwide, with children being particularly vulnerable. While medication and avoiding triggers play an important role in asthma management, underdiagnosis remains a significant issue in many countries.[1]

The hallmark of asthma is the variable narrowing of the airways. The Global Initiative for Asthma (GINA) describes asthma as a "heterogeneous disease, typically characterised by chronic airway inflammation. Asthma is defined by a history of respiratory symptoms such as wheezing, shortness of breath, chest tightness, and coughing that vary over time and in intensity, along with variable expiratory airflow limitation".[2]

Asthma affects people of all ages worldwide, but adolescents experience the highest rates of both prevalence and severity. According to the World Health Organization, approximately 8% of adults globally have asthma. However, the International Study of Asthma and Allergies in

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Childhood (ISAAC) Phase III reports a higher prevalence among adolescents (ages 13-14), with 10.6% of males and 7.9% of females affected.[3]

One method for assessing asthma control in a large population of secondary school-age children is the Asthma Control Test (ACT). This validated, simple measure allows clinicians and researchers to evaluate asthma control, with or without conducting lung function tests. The ACT uses an intuitive scoring system that provides a comprehensive assessment, helping to evaluate and improve asthma treatment. The questionnaire includes five questions covering the frequency of symptoms, nighttime symptoms, reliever medication use, and the patient's perception of control over the past four weeks.[4,5] The translated Arabic version of the Asthma Control Questionnaire is reliable for assessing pediatric patients in Arabic-speaking countries.[6]

The ACT is an effective tool for gauging the overall burden of asthma. Higher ACT scores are generally associated with better lung function, indicating that the test is a reliable measure of asthma control and its impact on lung health.[7] Poor asthma control is often caused by poor adherence to medication, which can result from irregular or inadequate medication use.[8] Proper asthma management positively influences school attendance, academic performance, social relationships, and participation in extracurricular activities. [9,10]

Developing effective asthma therapies requires a thorough assessment of symptoms. It is crucial to initiate a proper diagnosis and address any complications that hinder effective management. Comorbidities that significantly contribute to exacerbations should ultimately be addressed.[11]

The ACT assesses a patient's level of asthma control, with higher scores correlated with a lower likelihood of asthma flare-ups. The goal is to optimise the ACT score's benefits by determining how well it predicts patient outcomes. Additionally, limited research has explored the connection between asthma exacerbations and emergency department visits, making this an area of interest for further investigation. Understanding how ACT scores relate to exacerbation frequency is critical. While research has demonstrated the negative impact of asthma on school life, less is known about the factors influencing this impact. School performance of children with asthma may be affected by school conditions and their home and health status. Gaining insight into how these factors interact can help inform the development of preventative strategies and improve support for children with asthma.

This study was designed to assess asthma control status among students of second-stage intermediate schools in Baghdad, using the asthma control test to explore factors affecting uncontrolled asthma status

METHODS

Study design and setting: A cross-sectional study was conducted among grade 2 intermediate school students selected from all six educational directorates on both sides of Baghdad city from March to April 2024.

Ethical consideration: The relevant research ethics committee at the Ministry of Health approved the research protocol. Agreement to implement the study was obtained from the Technical Deputy Ministers of Health and Education. Consent was obtained by adding a message to the beginning of the questionnaire from the students/parents before enrolling in the electronic questionnaires.

Inclusion and exclusion criteria: Case definition; inclusion and exclusion criteria: grade 2 intermediate school students selected from all six educational directorates on both sides of Baghdad city, both genders and from urban and rural areas were the target of this study. We excluded private and religious schools from this study.

Sampling and sample size: A multi-stage cluster sampling technique was used to select the minimum representative sample size to estimate the prevalence of wheezing and asthma, depending on the role of population proportional size provided in the population

frame. Baghdad included six education directorates with 985 intermediate schools. A total of 145 clusters (classes) were randomly selected from the randomly included schools, which were the primary sampling units. The six educational directorates were addressed as the strata of this survey.

The sample size of the current survey was calculated using the following formula:

$$n = [(Z^2*q)/d^2)/1+(Z^2*q)/(d^2*N)*RR] * S$$

n= [(1.96)² * 0.5 (0.5)/ (0.05)²)/ 1 + (1.96)² * 0.5 (0.5)/ (0.05)2*147612) *0.8] *6 n= 2874 ~2900

- Z=1.96Z = 1.96Z=1.96 (for a 95% confidence level)
- q=0.5q = 0.5q=0.5 (default for baseline prevalence, which represents 50% exposure)
- d=0.05d = 0.05d=0.05 (margin of error)
- N=147,612N = 147,612N=147,612 (population size)
- RR=0.8RR = 0.8RR=0.8 (response rate, expected to be 80%)
- S=6S = 6S=6 (number of strata)

Data weighing (adjustment): It is essential to address the differences in sample proportions among strata to represent the target population accurately. To obtain weighted indicators, the sample of 2900 has been distributed across the educational directorates in Baghdad, proportionate to the number, gender, and residence of students in these directorates. The formula for data weighting is the inverse of the total probability of selecting students from the total population in the same grades, as follows:

W=1/P1*P2 , where

- W is the raw weight for the data.
- P1 is the proportion of students in the selected class relative to the total number of students in other classes of the same grade in the selected school.
- P2 Probability of the total number of students in grades in the selected school to the total number of students in the same grade in the educational sector.

The Application of the Asthma Control Test: We conducted the study by reaching out to the targeted population electronically, utilising the internet access provided for the school lessons that had already been set up by the school administration. The authors shared the survey link with the liaisons, who then forwarded it to the school principals. The principals, in turn, distributed the link to the selected classrooms through their teachers. The target group consisted of 2nd-degree intermediate school children who already had internet access to their lessons, making it easier to reach them for the online survey.

The e-questionnaire was sent to 2,900 selected students, and 264 students who reported having ever been diagnosed with asthma were included in the Asthma Control Test (ACT) questionnaire. Asthma was defined subjectively in this study based on the self-report of the students or their parents. The e-questionnaire link is **https://ee.kobotoolbox. org/x/2TrjnnSf**.

To monitor the progress of the study, electronic records were maintained using the Kobo Toolbox online database. Once the students completed the questionnaire, they submitted their responses by clicking the send button, which directly transferred the data to the Kobo Toolbox dashboard. The data collection period ran from March 2024 to the end of April 2024.

The ACT questionnaire categorises asthma control as either controlled or uncontrolled. A score between 20 and 25 on the five-item ACT questionnaire indicates controlled asthma, while a score of 19 or less suggests uncontrolled asthma.[4]

Limitations of the Study: Electronic surveys may not be accessible to everyone. Some individuals lack internet access, and some students may not have easy access to a computer or smartphone. Protecting respondents' sensitive personal information from unauthorised access is a critical concern.

Statistical Analysis: After data collection through Kobo Toolbox, the data were downloaded as Excel files and analysed using SPSS software, version 26. Categorical

Table 1 | Association of the student's control status with their sociodemographic characteristics and medication utilised.

Variables		Uncontrolled asthma (%)	Controlled asthma (%)	Total students with asthma (%)	P value
Education Directorate	Karkh 1	15 (68.2%)	7 (31.8%)	22 (8.3%)	0.006*
	Karkh 2	**10 (40%)**	**15 (60%)**	**25 (9.5%)**	
	Karkh 3	13 (50%)	13 (50%)	26 (9.8%)	
	Rusafa 1	11 (26.2%)	31 (73.8%)	42 (15.9%)	
	Rusafa 2	**39 (60.9%)**	**25 (39.1%)**	**64 (24.2%)**	
	Rusafa 3	43 (50.6%)	42 (49.4%)	85 (32.2%)	
Age in years	12	7 (63.6%)	4 (36.4%)	11 (4.2%)	0.233
	13	24 (58.5%)	17 (41.5%)	41 (15.5%)	
	14	53 (43.4%)	69 (56.6%)	122 (46.2%)	
	15	47 (52.2%)	43 (47.8%)	90 (34.1%)	
Sex	Boys	70 (51.9%)	65 (48.1%)	135 (51.1%)	0.458
	Girls	61 (47.3%)	68 (52.7%)	129 (48.9%)	
Residensy	Rural	30 (42.9%)	40 (57.1%)	70 (26.5%)	0.187
	Urban	101 (52.1%)	93 (47.9%)	194 (73.5%)	
Have used asthma-inhaled medicines in the past 12 months	Yes	48 (75%)	16 (25%)	64 (24.2%)	<0.001
	No	83 (41.5%)	117 (58.5%)	200 (75.8%)	
Have used tablets, capsules, liquids or other medicines for asthma in the past 12 months	Yes	66 (64.1%)	37 (35.9%)	103 (39%)	<0.001
	No	65 (40.4%)	96 (59.6%)	161 (61%)	

data were presented as frequencies and percentages, and Pearson's chi-square test of independence was used to assess associations between variables. A 95% confidence interval was used for the analysis.

RESULTS

Study Sample and Findings: The study targeted a sample of 2,900 students, with 2,835 students enrolled in the analysis—1,521 males and 1,314 females. Among these, 264 students who had ever been diagnosed with asthma completed the Asthma Control Test (ACT). Of these, 51% met the criteria for controlled asthma, while 49% had uncontrolled asthma.

Differences in Asthma Control by Directorate and Demographics: There were significant differences in asthma control across different directorates and demographic groups. The Karkh 1 Directorate had the highest rate of uncontrolled asthma, with 15 students (68.2%) reporting uncontrolled asthma, while the Rasafa 1 Directorate reported the lowest rate, with 11 students (26.2%). This difference was statistically significant, with a p-value of 0.006.

In terms of age, uncontrolled asthma was more prevalent among 11-year-olds (63.6%) compared to 15-year-olds (52.2%), with 7 and 47 students, respectively. However, this difference was statistically non-significant, with a p-value of 0.23.

Regarding sex, 61 girls (47.3%) and 70 boys (51.9%) were affected by uncontrolled asthma, but this difference was also statistically non-significant (p-value = 0.458). Similarly, asthma control rates were higher in rural areas (57.1%) compared to urban areas (47.9%), but this difference was non-significant as well (p-value = 0.187).

Medication Use and Asthma Control: A significant association was found between asthma control and the use of asthma medications. Among students who had used asthma inhalers in the last 12 months, 48 (75%) had uncontrolled asthma, compared to 83 (41.5%) of those who had not used inhalers, with a p-value of <0.001. Similarly, a higher rate of uncontrolled asthma was observed among students who had used oral medications (tablets, capsules, liquids, or other medicines)

Table 2 | Association of the students control status with severity.

Variables		Uncontrolled asthma (%)	Controlled asthma (%)	Total students with asthma (%)	P value
Times urgently been to a doctor for Breathing problems without admission in the last 12 months	Never	78 (39.2%)	121 (60.8%)	199 (75.4%)	<0.001
	1 - 3 times	40 (78.4%)	11 (21.6%)	51 (19.3%)	
	4 - 12 times	4 (80%)	1 (20%)	5 (1.9%)	
	> 12 times	9 (100%)	0 (0%)	9 (3.4%)	
Times urgently been to an Emergency Department for Breathing problem without admission in the last 12 months	Never	95 (42.4%)	129 (57.6%)	224 (84.8%)	<0.001
	1 - 3 times	26 (86.7%)	4 (13.3%)	30 (11.4%)	
	4 - 12 times	3 (100%)	0 (0%)	3 (1.1%)	
	> 12 times	7 (100%)	0 (0%)	7 (2.7%)	
Times has urgently been admitted to hospital for Breathing problem in the last 12 months	Never	109 (45.6%)	130 (54.4%)	239 (90.5%)	<0.001
	1 time	12 (85.7%)	2 (14.3%)	14 (5.3%)	
	2 times	4 (80%)	1 (20%)	5 (1.9%)	
	> 2 times	6 (100%)	0 (0%)	6 (2.3%)	
Days (or part days) of school have been missed because of breathing problems in the last 12 months.	Never	90 (41.5%)	127 (58.5%)	217 (82.2%)	<0.001
	1 - 3 times	27 (81.8%)	6 (18.2%)	33 (12.5%)	
	4 - 12 times	7 (100%)	0 (0%)	7 (2.7%)	
	> 12 times	7 (100%)	0 (0%)	7 (2.7%)	

for asthma in the past 12 months—66 students (64.1%) with uncontrolled asthma compared to 65 students (40.4%) who had not used these medications, with a p-value of <0.001.

For details of other associations, refer to **Table 1**.

Association with Medical Visits and School Absenteeism: **Table 2** shows that uncontrolled asthma was significantly associated with urgent visits to doctors due to breathing problems in the last 12 months, urgent visits to hospitals without admission, urgent visits to hospitals with admission due to breathing problems, and the duration of missed school days due to breathing problems, with p-values for all associations equal to 0.001.

DISCUSSION

Asthma control is achieved when lung function is improved, symptoms are less severe and less frequent, acute symptoms and the risk of future exacerbations are minimised, daily as-needed therapy usage is reduced, and the potential adverse effects of rescue medications, such as systemic corticosteroids, are diminished.[12,13] Moreover, it is well-established that failing to achieve asthma control is linked to increased future risks of exacerbations, emergency room visits, hospital stays, reduced lung function, declining quality of life, and higher healthcare costs.[14]

The Asthma Control Test (ACT) is a simple and effective tool for assessing a patient's level of asthma symptom control. By utilising this tool, healthcare providers can evaluate the effectiveness of treatments and tailor the maintenance and adjustment of treatment for individual patients.[15]

In our study, we found that fewer than half of the participants achieved controlled asthma, a result consistent with the findings of Hugo et al. (2020), who reported that less than half of the participants were classified as having controlled asthma.[16]

Our study revealed that 75% of participants who used inhaled medications in the past 12 months had uncontrolled asthma. This finding was significantly associated with asthma control status. This result aligns with the study by Lida et al. (2017), which demonstrated that uncontrolled asthma is often indicated by excessive use of short-acting beta-2 agonists (SABA). Most individuals with uncontrolled

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asthma also exhibit poor long-term adherence to inhaled corticosteroids.[17] The high prevalence of uncontrolled asthma in this study group may be due to insufficient knowledge and improper usage of inhaled medications or a negative attitude toward using these medications among adolescents.

Our study also found a significant association between uncontrolled asthma status and the frequency of urgent doctor visits for breathing problems, both with and without hospital admission. These findings are consistent with those of Lai et al. (2011), who identified a significant association between uncontrolled asthma and increased urgent healthcare utilisation, including visits to emergency departments.[18]

The current study revealed that using tablets, capsules, liquids, or other medications for asthma management in the past 12 months was more common among participants in the asthma-controlled group. This was significantly associated with controlled asthma status. These findings align with the study by Barnes et al. (2019), which highlighted that over-reliance on relief therapies and underuse of maintenance controller medications are primary contributors to poor asthma control. [19] This could be due to inappropriate dosing, treatment duration, or improper administration techniques within the current study population.

Our study also found that asthma control status significantly impacted school absenteeism, with a marked association between asthma control and the number of school days missed. This result is consistent with studies by Toyran et al. (2020) and Kim et al. (2020), both of which showed a significant association between higher asthma severity, poorer control, and increased absenteeism. [20, 21]

CONCLUSION

About half of children with asthma servayed by ACT were uncontrolled. Students with asthma who reside in urban areas had better asthma control than their rural counterparts, and boys exhibited poorer control than girls. Factors such as the use of inhaled medications, tablets and capsules, increased visits to doctors or emergency departments, hospital admissions due to breathing problems, and missed school days due to asthma symptoms were all significantly associated with uncontrolled asthma status, as assessed by the ACT.

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