A study to assess the factors affecting attainment of control and acute exacerbations in children treated for asthma

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Abstract
Background: The Asthma Guidelines of the National Asthma Education and Prevention Program (NAEPP) published by the National Institutes of Health (NIH) emphasize the need to evaluate asthma control as a key component for asthma treatment and management. Well-controlled asthma is associated with improved health status, and fewer physician visits, hospitalizations and emergency room visits among children and adults. In contrast, poor asthma control is directly linked with increased school absenteeism and loss in work productivity among asthma children and adults/caregivers, respectively. Unfortunately, studies report that asthma remains uncontrolled in many asthmatic patients, despite receiving appropriate treatments. Present study has been designed to update the knowledge regarding factors affecting asthma control and factors responsible for frequent exacerbations in children so that corrective measures could be taken.
Objectives: To assess and classify children as per the GINA guidelines into levels (mild, moderate, severe) of asthma as well as control of asthma (controlled/ not well controlled and poorly controlled).
Methods: A cross-sectional observational study was conducted among 40 children visiting the pediatric chest clinic with age group above 3 year and less than 12 years and diagnosed as asthma for a period of 3 months at Department of Pediatrics, G S Seth Medical College. Patients with undocumented diagnosis of asthma, Patients having other lung co-morbidities, including congenital (e.g., cystic fibrosis, known immunodeficiencies, etc) and acquired airway disorders (like bronchiectasis, lung abscess, etc) were excluded from the study. A written informed consent for the same was obtained from the parents/guardians of potential cases for enrollment. Assent was also be sought from children above 7 years of age. All enrolled cases were subjected to detailed clinical evaluation and review of pulmonary function test reports and the pertinent data were recorded on a predesigned Case record form- CRF. All cases were assigned a case number.
Results: The age of children was ranging from 3yr to 12 yr with mean age of 8.15 years with SD 2.4. In this study 37.5% were boys and 62.5% were girls. In study group 57.5% patients had family history of asthma while 42.5% patients did not have family history of asthma. 77.5% patients had history of exposure to smoke while 22.5% patients did not have history of exposure to smoke. Mean number of exacerbations were 4.6 with SD 4.2. Mean number of exacerbations requiring admissions were 1.65 with SD of 2. 20% patients belong to Upper middle class, while 80% patients belong to lower middle class.

Thus, out of 40 patients, 9 were of intermittent, 15 were of mild persistent, 12 were of moderate persistent, 4 were of severe persistent asthma.

out of 40 patients 23 were controlled and 17 were partially controlled/not controlled as per GINA guidelines. Correct use of inhaler was observed in 31 (77.5 %) enrolled patients. Errors in use of inhaler was seen in the remaining 9 (22.5%) patients. Out of 40 enrolled patients 92.5% patients were adherent to inhaled corticosteroids prescribed to them. 7.5% patients were nonadherent. From above study it was observed that reason for nonadherence in 3 (2.5%) patients each were bad taste, perception of addiction liability by parent and social embarrassment in taking MDI respectively. It was found that in our study age, Parent education, Usage of inhaler technique, Adherence of ICS and Socioeconomic status was analyzed and found to be statistically insignificant for all the variables for control of asthma. The episodes of Asthma attach among the study subjects was found to be statistically insignificant for all the variables.

Conclusion: The Study concluded that number of exacerbations were observed in cases nonadherent to ICS than those cases who were adherent to ICS. Though research has shown that good control can be achieved in most patients and valid tools are available to reach this aim, the reality in clinical practice is that asthma remains poorly controlled. That can be considered the result of the complex interaction among different variables.

Keywords: Asthma, Acute Exacerbations, Children

Introduction

Asthma is a chronic inflammatory disease of the airways, resulting in widespread but variable airflow obstruction in response to a variety of stimuli [1]. National and international guidelines clearly state that the aim of asthma management is to achieve and maintain control [1, 2].

Controlled asthma is characterized by minimal or no symptoms during the day and at night, no asthma attacks, no emergency visits to physicians or hospitals, minimal need for reliever medications, no limitations on physical activities and exercise, nearly normal lung function and minimal or no side-effects from medication. With the medical treatments currently available, it is possible to achieve control in the majority of patients with asthma, at least in the artificial setting of a clinical trial [3].

However, in the real world where patients make choices that may reflect conflicting priorities, asthma still imposes a considerable burden on healthcare systems, largely as a result of poor control. There is evidence, from a 10 year Finish study, that enhancing the delivery of healthcare services, can improve asthma control [4].

An analysis of nine studies conducted in Australia, Canada, France, Sweden, UK and USA showed that around one third of the direct costs of asthma and three quarters of the total costs of asthma, were a consequence of uncontrolled disease [5].

The Asthma Guidelines of the National Asthma Education and Prevention Program (NAEPP) published by the National Institutes of Health (NIH) emphasize the need to evaluate asthma control as a key component for asthma treatment and management. Well-controlled asthma is associated with improved health status and fewer physician visits, hospitalizations and emergency room visits among children and adults [6, 7, 8, 9, 10].

In contrast, poor asthma control is directly linked with increased school absenteeism and loss in work productivity among asthma children and adults/caregivers, respectively. Unfortunately, studies report that asthma remains uncontrolled in many asthmatic patients, despite receiving appropriate treatments.

Present study has been designed to update the knowledge regarding factors affecting asthma control and factors responsible for frequent exacerbations in children so that corrective measures could be taken.

Objective: To assess and classify children as per the GINA guidelines into levels (mild, moderate, severe) of asthma as well as control of asthma (controlled/ not well controlled and poorly controlled).

Material and Methods

This study was a cross-sectional observational study in prospective time frame. It was carried out from April 2017 to June 2017 over a period of 3 months by the Department of Pediatrics, G S Seth Medical College.

A total of 40 Study subjects were selected for the purpose of the study by convenient sampling technique. For each patient, past data was analyzed for past one year retrospectively. It was a hospital outpatient department-based study, included only the patients following in paediatric chest clinic.

Inclusion criteria for this study were included: All children visiting the pediatric chest clinic with age group above 3 year and less than 12 years and diagnosed as asthma.

Exclusion criteria for this study were included:

- Patients with undocumented diagnosis of asthma.
- Patients having other lung co-morbidities, including congenital (e.g., cystic fibrosis, known immunodeficiencies, etc.) and acquired airway disorders (like bronchiectasis, lung abscess, etc.)

Methodology: This study was conducted in following steps–

- **Screening:** All children between 3 to 12 years following pediatric chest clinic during the study period was assessed and classified as per the GINA guidelines into levels (mild, moderate, severe) of asthma as well as control of asthma (controlled/not well controlled and poorly controlled) and consecutive 40 diagnosed cases were recruited in the study. Parents of these cases were invited to join the study after personal counseling and offering them the patient information sheet.
- **Consent:** A written informed consent for the same was obtained from the parents/guardians of potential cases for enrollment. Assent was also be sought from children above 7 years of age.

Enrollment: All cases fulfilling of inclusion and exclusion criteria, discussed earlier, were enrolled for the study. Data collection: All enrolled cases were subjected to detailed clinical evaluation and review of pulmonary function test reports and the pertinent data were recorded on a predesigned Case record form-CRF. All cases were assigned a case number.

Results

The present study was conducted in KEM Hospital Pediatric chest clinic outpatient department patients. Children visiting the pediatric chest clinic with age group above 3 year and less than 12 years and diagnosed as asthma were included. A total of 40 students were enrolled. The study was carried out during 3 month period, from April 2017 to June 2017. All enrolled cases were subjected to detailed clinical evaluation and review of pulmonary function test reports and the pertinent data of past one year were recorded on a pre-designed Case record form-CRF.

Table 1: Social Profile of the study subjects

		Frequency	Percentage
Gender	Male	15	37.5
	Female	25	62.5
Family History	Yes	09	22.5
	No	31	77.5
Socio Economic Status	Upper Middle Class	8	20
	Lower Middle Class	32	80

the age of children was ranging from 3yr to 12yr with mean age of 8.15 years with SD 2.4. In this study 37.5% were boys and 62.5% were girls. In study group 57.5% patients had family history of asthma while 42.5% patients did not have family history of asthma. 77.5% patients had history of exposure to smoke while 22.5% patients did not have history of exposure to smoke. Mean number of exacerbations were 4.6 with SD 4.2. Mean number of exacerbations requiring admissions were 1.65 with SD of 2. 20% patients

belong to Upper middle class, while 80% patients belong to lower middle class.

Table 2: Classification of Study Population based on the severity of Asthma

		Frequency	Percentage
Severity of Asthma	Intermittent	9	22.5
	Mild Persistent	15	37.5
	Moderate Persistent	12	30
	Severe Persistent	04	10

Thus out of 40 patients, 9 were of intermittent, 15 were of mild persistent, 12 were of moderate persistent, 4 were of severe persistent asthma.

Out of 40 patients 23 were controlled and 17 were partially controlled/not controlled as per GINA guidelines. Correct use of inhaler was observed in 31 (77.5 %) enrolled patients. Errors in use of inhaler was seen in the remaining 9(22.5%) patients. Out of 40 enrolled patients 92.5% patients were adherent to inhaled corticosteroids prescribed to them. 7.5% patients were nonadherent. From above study it was observed that reason for nonadherence in 3 (2.5%) patients each were bad taste, perception of addiction liability by parent and social embarrassment in taking MDI respectively.

Table 3: Association between the control of asthma and various other factors

		Well controlled	Not well controlled/very poorly controlled	P value
Age Group	Less than 5 years	06(75%)	02(25%)	0.33
	More than 5 years	17(53.1%)	15(46.8%)	
Parents Education	Above Primary School	20(57.1%)	15(42.8%)	0.90
	Below Primary School	03(60%)	02(40%)	
Inhaler technique	Using inhaler correctly	19(61.2%)	12(38.7%)	0.36
	Not using inhaler correctly	04(44.4%)	05(55.5%)	
Adherence to ICS	Adherent	22(70.9%)	15(29.03%)	0.32
	Not Adherent	01(33.3%)	02(66.7%)	
Socioeconomic Status	Upper Middle Class	4(50%)	4(50%)	0.63
	Lower Middle Class	19(59.3%)	13(40.6%)	

It was found that in our study age, Parent education, Usage of inhaler technique, Adherence of ICS and Socioeconomic status was analyzed and found to be statistically insignificant for all the variables for control of asthma.

Table 4: Association between the Exacerbation of asthma and various other factors

		1-3 per episodes per year	More than 3 per year	P value
Age Group	Less than 5 years	05(62%)	03(37%)	0.74
	More than 5 years	18(56%)	14(43%)	
Parents Education	Above Primary School	20(57%)	15(42%)	0.90
	Below Primary School	03(60%)	02(40%)	
Inhaler technique	Using inhaler correctly	19(61%)	12(38%)	0.36
	Not using inhaler correctly	04(44%)	05(55%)	
Adherence to ICS	Adherent	22(59%)	15(40%)	0.77
	Not Adherent	01(33%)	02(66%)	
Socioeconomic Status	Upper Middle Class	04(50%)	04(50%)	0.63
	Lower Middle Class	19(59%)	13(40%)	

The episodes of Asthma attach among the study subjects was found to be statistically insignificant for all the variables.

Discussion

The present study was conducted in KEM Hospital Pediatric chest clinic outpatient department patients. Children visiting the pediatric chest clinic with age group above 3 year and less than 12 years and diagnosed as asthma were included. A total of 40 students were enrolled.

In the present study the age of cases was ranging from 3-12 years with average age of 8.15 years. Better control of asthma was observed in younger patients 5yrs (17%). According to a study conducted by C.E. Kuehni *et al*. [11] asthma control was more in older age group. With a response rate of 85%, data from 572 Swiss-German children aged 4-16 yrs with wheeze were analysed. Asthma control was excellent in 18% of the children, satisfactory (only episodic symptoms) in 33%, and unsatisfactory in 49% with disturbed sleep, restricted activities and school absences.

More number of exacerbations (>3per year) were observed in older (>5yrs) patients (43%) than in younger patients (37%). According to a study conducted by Kiyoshi Sekiya *et al*., in the young age group, the percentages of patients with frequent exacerbations were high [12].

In 60% cases with parent education below primary schooling had better asthma control compared to 20% cases with parent education above primary schooling. According to study conducted by Sandra R. Wilson *et al*. parent education can improve asthma control. A randomized control trial of the Wee Wheezers

asthma education program was conducted with 76 children < 7 years of age, 31% of whom were on a medication regimen consistent with mild, 51% with moderate and 18% with moderately severe/severe asthma. Improvements were accompanied by significantly better parental asthma management compared with controls vention and trends toward decreased parental confusion about asthma treatment [13].

More number of exacerbations (42%) were observed in cases with parent education above primary schooling as compared to cases with education below primary schooling (40%). According to a study conducted by Jamie N Deis *et al*. Parents with more than a high school education are more confident in their ability to provide care for their child during an asthma before and during exacerbation [14].

Better asthma control was observed in 61.2% cases with correct use of inhaler technique as compared to 44.4% with poor use of inhaler technique. According to a study conducted by Federico Lavorini *et al*. incorrect DPI technique with established DPIs is common among patients with asthma and COPD, and suggests that poor inhalation technique has detrimental consequences for clinical efficacy. The search strategy included primary and secondary sources. MEDLINE (1966-2005) and EMBASE (1988-2005) were used for the search in primary sources [15].

More number of exacerbations 55% was observed in cases with improper inhaler technique than who used inhaler correctly 38%. According to a study conducted by Hamdan AL-Jahdali *et al*. improper inhaler technique is associated with poor asthma control and frequent emergency department visits. A total of 450 asthma patients were included in the study. Of these, 176(39.1%) were males with a mean age of 42.3 ± 16.7 years and the mean duration of asthma was 155.9 ± 127.1 weeks. The improper use of asthma inhaler devices was observed in 203(45%) of the patients and was associated with irregular clinic follow-ups ($p = 0.0001$), lack of asthma education ($p = 0.0009$), uncontrolled asthma ACT (score ≤ 15) ($p = 0.001$), three or more ED visits ($p = 0.0497$), and duration of asthma of less than 52 weeks ($p = 0.005$). Multiple logistic regression analysis revealed that a lack of education about asthma disease (OR $=1.65$; 95% CI: 1.07, 2.54) or a lack of regular follow-up (OR $=1.73$; 95% CI: 1.08, 2.76) was more likely to lead to the improper use of an asthma inhaler device [16].

Better asthma control was observed in 70%% patients adherent to ICS as compared to only 1% patients who were not adherent to ICS. According to a study conducted by Nulma S. Jentzsch *et al*. [17] the level of asthma control was directly proportional to adherence rate. In this prospective cohort study, 102 steroid naïve randomly selected subjects with persistent asthma, aged 5-14 years were prescribed 500-750 μg daily of BDPCFC and followed during one year. More number of exacerbations were observed in cases nonadherent to ICS (66%) than those cases who were adherent to ICS (40%). In a study conducted by Erwin C Vasbinder *et al*., in children with persistent asthma needing long-acting a total of 646 children were included, of whom 36 had one or more asthma exacerbations. The medication possession ratio was

67.9% (standard deviation [SD] 30.2%) in children with an exacerbation versus 54.2% (SD 35.6%) in the control group. In children using long-acting beta-agonist, good adherence to ICS was associated with a higher risk of asthma exacerbations: relative risk 4.34 (95% confidence interval: 1.20-15.64) [18].

Conclusion

In the present study we could conclude that more number of exacerbations were observed in cases nonadherent to ICS than those cases who were adherent to ICS. Though research has shown that good control can be achieved in most patients and valid tools are available to reach this aim, the reality in clinical practice is that asthma remains poorly controlled. That can be considered the result of the complex interaction among different variables.

References

1. Global Initiative for Asthma (GINA): GINA. [http://www.ginas thma.com].
2. BTS British Thoracic Society/Scottish Intercollegiate Guidelines Network: Guidelines on asthma management. Thorax. 2003;58(1):i1-i94.
3. Bateman ED, Boushey HA, Bousquet J, Busse WW, Clark TJ, Pauwels RA *et al*.: Can guideline-defined asthma control be achieved? The Gaining Optimal Asthma ControL study. American Journal of Respiratory Critical Care Medicine. 2004;170(8):836-844.
4. Haahtela T, Klaukka T, Koskela K, Erhola M, Laitinen LA. Asthma programme in Finland: a community problem needs community solutions. Thorax. 2001;56(10):806-814.
5. Barnes PJ, Jonsson B, Klim JB. The costs of asthma. European Respiratory Journal. 1996;9(4):636-642.
6. Wyrwich KW, Ireland AM, Navaratnam P, Nolte H, Gates DF. An assessment of change in asthma control among adolescents and adults with persistent asthma in mometasone furoate/formoterol fumarate clinical trials. J Asthma. 2011;48:48-56.
7. National Heart Lung and Blood Institute: National Education and Prevention Program Expert Panel Report 3: guidelines for the diagnosis and management of asthma, 2007. www.nhlbi.nih.gov/guidelines/asthma/asthgdln.htm.
8. Joint Task Force on Practice Parameters, American Academy of Allergy, Asthma and Immunology; American College of Allergy, Asthma and Immunology and Joint Council of Allergy, Asthma and Immunology: Attaining optimal asthma control: a practice parameter. J Allergy Clin Immunol. 2005;116(5):3-11.
9. Diette GB, Sajjan SG, Skinner EA, Weiss TW, Wu AW, Markson LE. Using the pediatric asthma therapy assessment questionnaire to measure asthma control and healthcare utilization in children. Patient. 2009;2(4):233-241.
10. Bateman ED, Bousquet J, Keech ML, Busse WW, Clark TJ, Pedersen SE. The correlation between asthma control and health status: the GOAL study. Eur Respir J. 2007;29:56-62.
11. Kuehni CE, Frey U. Age-related differences in perceived asthma control in childhood: guidelines and reality. European Respiratory Journal. 2002;20(4):880-889.
12. Kiyoshi Sekiya *et al*. Age-Specific Characteristics of Inpatients with Severe Asthma Exacerbation Allergology International. 2013;62:331-336.
13. Wilson Sandra R. *et al*. Education of parents of infants and very young children with asthma: a developmental evaluation of the Wee Wheezers program. Journal of Asthma. 1996;33(4):239-254.
14. Deis JN, Spiro DM, Jenkins CA, Buckles TL, Arnold DH. Parental Knowledge and Use of Preventive Asthma Care Measures in Two Pediatric Emergency Departments. The Journal of asthma : official journal of the Association for the Care of Asthma, 2010, 47(5). 10.3109/02770900903560225. Doi: 10.3109/02770900903560225.
15. Lavorini Federico *et al*. Effect of incorrect use of dry powder inhalers on management of patients with asthma and COPD. Respiratory medicine. 2008;102(4):593-604.
16. Hamdan AL-Jahdali *et al*., Improper inhaler technique is associated with poor asthma control and

frequent emergency department visits Allergy, Asthma & Clinical Immunology. 2013;9:8.

17. Jentzsch, Nulma S, *et al*. Adherence rate to beclomethasone dipropionate and the level of asthma control. Respiratory medicine. 2012;106(3):338-343.

18. Vasbinder, Erwin C, *et al*. Non-adherence to inhaled corticosteroids and the risk of asthma exacerbations in children. Patient preference and adherence. 2016;10:531.