COMPLIANCE OF PROPHYLACTIC INHALATION CORTICOSTEROID THERAPY IN ASTHMA IN CHILDREN

By

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In

PAEDIATRICS

Under the guidance of

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is a bonafide and genuine research work carried out by me

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Dr.Akshay Ballal

ABSTRACT

Need for study:

The prevalence of asthma is increasing worldwide, especially in young children. Successful asthma management in children depends on their compliance with prophylactic inhalation therapy, which is often poor. Troublesome consequences of non compliance include uncontrolled symptoms day and night, limitation of lifestyle and the need for emergency intervention by the practitioner. Hence this study was done to ascertain the rate of non compliance and reasons for non compliance in a rural area in India.

Material and methods:

The study was undertaken in the Respiratory medicine OPD, Dept Of Pediatrics of Sri Devraj URS Medical College and Research Institute,Kolar, during the period 1st December 2009 to 1st June 2011. Children above 2 years and below 18 years of age who were previously diagnosed to have asthma and prescribed prophylactic inhaled steroids at the time of discharge were included. Patients received budesonide 100 – 200 µg twice daily according to the NAEPP classification of asthma severity. Patients were followed up every 6 months for a minimum of 2 visits. At each follow up, review of asthma diary, completion of questionnaire and complete physical examination were done.

Results:

A total of 95 patients were studied in the present study. The mean age was 7.4 yrs.43(45%) children did not show compliance to their medications. Age and sex were not significant risk factors.Degree of severity of disease, socioeconomic status and caregiver education were significant risk factors for non compliance.Lack of knowledge of disease was found to be the main reason for non compliance in this study.Parental health beliefs and cost were also significant reasons for non compliance.

Conclusion:

Poor compliance to inhaled steroids was observed in this study.Lack of knowledge of disease process was found to be major reason for non compliance.Better asthma education and a written action plan should be given to improve compliance among asthmatics.

Keywords

Compliance, asthma, children

TABLE OF CONTENTS

INTRODUCTION

Asthma is the most common chronic disease of childhood. It is defined as a chronic inflammatory condition of airways that is associated with increased responsiveness to a variety of stimuli. Out of nearly 200 million asthmatics world over, approximately 15 million are in India. Prevalence of bronchial asthma is over 5% in children in our country and the burden is constantly increasing. Poorly controlled asthma is associated with significant morbidity and socio-economic problems like absenteeism from school and a poor quality of life. Bronchial asthma impairs not only respiratory function, but also physical, social and emotional components of life. Studies have reported increased adaptation problems in children with asthma and these have been attributed to occur due to adverse developmental impact of having a chronic illness, psychosocial stress on the family, and repeated encounters with medical personnel. Low income children are more likely to have greater asthma severity and higher hospitalisation rates.There has been an increase in mortality as well in the younger age groups. Inhaled corticosteroids are prophylactic drug therapies that reduce the likelihood of asthma and frequent hospitalisation. They have become an integral part of asthma treatment guidelines. By reducing inflammation, inhaled steroids reduce the need for rescue bronchodilator therapy and hospitalization, improve pulmonary functions, reduce bronchial hyper-responsiveness and reduce deposition of collagen and tenascin in the airway mucosa. Because of its several advantages, inhalation therapy has become the treatment of first choice in the western countries. Children on inhalation therapy feel and function better than before suggesting improved quality of life.

OBJECTIVES OF THE STUDY

- To know the compliance of inhalational corticosteroid therapy in children suffering from asthma.
- To know the reasons for non compliance and suggest interventions accordingly.

Asthma: Definition and Risk Factors

As the most common chronic respiratory disorder, approximately 300 million people worldwide currently have asthma, with estimates suggesting that asthma prevalence increases globally by 50% every decade[1]. In a classroom of 30 children, an average of three are likely to have this disorder [2]. Asthma is a chronic inflammatory disorder of the bronchial airways. In susceptible individuals, inflammation (swelling of the airways) causes recurrent episodes of wheezing, breathlessness, chest tightness, and coughing, particularly at night or in the early morning[3]. These episodes of inflammation are usually associated with extensive, but erratic airflow obstruction and tightening of the muscles around the airways[4]. Although asthma severity differs across individuals, almost all children with asthma experience a relief from symptoms or reversal, between episodes[5].

Asthma has a multifactorial origin with both genetic and environmental causes and gene-environment interactions[6]. It is a heterogeneous disease in which classifications can be defined on basis of phenotypes. These phenotypes are based on a wide variety of parameters: 1) symptoms (age of onset, severity), 2) triggers (atopy, exercise induced, virus triggered, multiple trigger wheeze, exacerbation prone), 3) response to treatment (mainly to corticosteroids), 4) pathophysiological (eosinophilic or neutrophilic inflammation in biopsies, induced sputum samples and broncho-alveolar lavage), 5) physiological measurements (bronchial hyper responsiveness, severity of airway obstruction), and 6) genetic polymorphisms[7,8]. There is a major overlap between these phenotypes[9]. At present, multivariate cluster analysis is being used to reorganize classification of asthma phenotypes

in order to increase understanding of asthma aetiology[10]. An increased number of studies are being performed concerning the genetics of asthma. For example, genes discovered to be involved in the pathophysiology of asthma include toll-like receptor genes[11,12], which may be X-chromosome linked[13] and genetics of interferon regulatory factor (IRF)-1[14-16]. The relationship between phenotypes, genotypes and responds to treatment is not clear yet.

Asthma exacerbations during which patients experience an increase in respiratory symptoms may be provoked by: 1) viral infections, most commonly rhinovirus, respiratory syncytial virus and influenza. In 2008, it is estimated that 80% of the asthma exacerbations were associated with viral infection[17]. Mononuclear cells are activated in the airways. Consequently, airway monocytes, macrophages and dendritic cells secrete proinflammatory cytokines, adhesion molecules and chemokines excite inflammatory cell recruitment. The neutrophil response accompanied with acute respiratory infections contributes to airway obstruction and bronchial hyper responsiveness. 2) Atopy and allergic rhinitis. This inflammatory process is mainly based on mast cell degranulation and an eosinophilic response. In addition, activation of regulatory T-lymphocytes result in a dysbalance of T helper 1 and 2 lymphocytes, which is the major immunological pathway behind atopy. 3) Non-specific stimuli like smoke, fog, cold air, and exercise.

Prevalence of childhood asthma

Asthma is the most common chronic disorder of childhood and affects an estimated 6.7 million children[18]. In 2007, a rate of 77.1 per 1,000 of the total population had asthma. The

highest prevalence rate was seen among those 5 – 17 years of age (99.9 per 1,000 population). Overall, the rate in those under 18 (90.9 per 1,000) was significantly greater than those over 18[18,19]. Asthma is a global problem. The World Health Organisation (WHO) recognises the drastic need to reduce asthma deaths by half. It is estimated that 25,000 children die every year from asthma. The Global Initiative for Asthma (GINA) which includes the US National Heart, Lung,and Blood Institute and the European Respiratory Society also plan to cut the number of childhood hospitalisations due to asthma by a quarter. This initiative plans to half the school days missed due to asthma by children.

There is a wide variation in the prevalence of asthma within Southern Asia[20]. In India, a tenfold variation in the prevalence of childhood asthma has been observed. India is projected to become the world's most populous nation by the year 2050. As a result, further predicted increases in the prevalence of asthma will result in a marked increase in the number of asthmatics. For example, if the prevalence of asthma in the region increases by an absolute 2%, then this will result in at least an additional 20 million asthmatics in the region.

As part of the International Study of Asthma and Allergies in Childhood (ISAAC) study[20], prevalence surveys were conducted among representative samples of school children from locations in Europe, Asia, Africa, Australia and North and South America. In total, 2,57, 800 children aged 6–7 years from 91 centres in 38 countries and 4,63,801 children aged 13–14 years from 155 centres in 56 countries were surveyed. Within each age group, the global pattern was broadly consistent across each of the symptom categories. The lowest prevalence of asthma was found in parts of Eastern Europe and South and Central Asia. In Asia, the prevalence ranged from 1.5% in Nepal to 6.2% in Hong Kong and the United Arab Emirates.

The proportion of current wheezers with severe asthma symptoms was higher in Africa, the Indian subcontinent and the Eastern Mediterranean than in the English language countries for both age groups. This suggests that the disease may be clinically more severe in these less affluent countries than the more affluent English language countries, although the latter have amongst the highest symptom prevalence of asthma worldwide. Although prevalence data of allergic diseases in India is scarce, the little data that are available suggest that patterns differ in different areas[20].

There was low prevalence of Bronchial Asthma (1% – 3.3%) in the children surveyed in Lucknow[21], Ludhiana[22], and Punjab[23], while in Delhi the prevalence of bronchial asthma was 11.6% [24]. Paramesh H *et al* [25] in Bangalore did a hospital based study on 20,000 children under the age of 18 years from 1979,1984,1989,1994 and 1999 in the city of Bangalore, and showed a prevalence of 9%, 10.5%,18.5%, 24.5% and 29.5% respectively. Rise in prevalence over time in Bangalore has been associated with environmental pollution, urbanization and change in demography of the city[25]. Paramesh[25] also found that among children 6-15 years of age, the prevalence of asthma in urban children was 16.6% while in rural children it was 5.7%. Among urban children, a higher prevalence of asthma was found among children exposed to heavy traffic, thereby acknowledging the presence of outdoor air pollution as a triggering factor. Animesh Jain et al[26] conducted a cross sectional community based study in Mangalore by interviewing the parents of randomly selected 559 children in the age group of 6 – 15 yr using the ISAAC questionnaire and reported a prevalence of 10.3% in 2010. Gupta *et al.*[27] observed an asthma prevalence of 2.6% for boys and 1.9% for girls in Chandigarh.The study done in urban and rural children in Tamil Nadu in the age group of (6 – 12) years showed prevalence of wheeze of 18% [28].

In a recent landmark Indian study, the researchers found a consistent association between being exposed to, and having experienced domestic violence, and childhood asthma prevalence in India. In an age-stratified analysis, a strong association was observed in age groups of under-five, 5 – 14, 15 – 24, and 25 – 44 years. Stress-induced mechanisms, partially captured through violence and social circumstances, may be a missing link in furthering our understanding of the social disparities in asthma.

Negative Consequences of Asthma

Asthma, if unmanaged or undermanaged, can result in a number of avoidable complications including emergency room visits, hospitalizations, deaths, as well as permanent narrowing of the bronchial tubes and slowed growth in children from long term use of corticosteroids[3].Childhood asthma has an array of negative consequences such as school absenteeism and high economic burden. Asthma is one of the leading causes of school absence overall, and the most common cause of school absence due to chronic illness[30]. In 2003 asthma accounted for an estimated 12.8 million lost school days among the more than 4 million children who reported at least one asthma attack in the preceding year[31]. As part of a project of the National Coordinating Committee on School Health and Safety, Taras and Potts-Datema (2005) reviewed the literature on the relationship between childhood asthma, school absenteeism, and academic outcomes (achievement and ability). The 66 included studies were published in peer-reviewed journals. Nearly all of them reported a correlation between asthma and high rates of school absence. The association between asthma and

academic outcomes is less conclusive. Approximately two thirds of the reviewed studies found no difference between children with asthma and their asthma-free peers on levels of academic achievement or ability.

Studies have also found that children suffering from asthma have a lessened quality of life due to their condition[32].

Disability-adjusted life years (DALYs) is a measure of the burden of disease that assesses the years of healthy life lost due to disease or illness. DALYs combine information about morbidity and mortality in terms of healthy years lost. The number of DALYs lost due to asthma worldwide has been estimated to be about 15 million/year. Worldwide, asthma accounts for around 1% of all DALYs lost, which reflects the high prevalence and severity of asthma. Asthma was the 25th leading cause of DALYs lost worldwide in 2001.Asthma is known to reduce the quality of life of its sufferers[33].Most studies relating to quality of life come from the developed world. Appropriate measures to estimate quality of life in developing countries with diverse cultural beliefs, values and convictions are practically non-existent. Some attempts have been made in this direction but the wider applicability of these measures needs to be validated[34].

The economic impact of asthma is substantial. The direct costs of a disease are defined as resources consumed: (a) costs associated with drugs and devices; (b) consultations with physicians; and (c) hospital costs. The indirect costs of a disease are defined as resources lost: (a) time off work as a result of the ill health of the patient; (b) time spent by people looking after the patient in the home; and (c) premature retirement or death (Barnes, Jonsson, & Klim,

1996). The total direct and indirect costs of asthma per year in the US are estimated to be $18.3 billion (Asthma and Allergy Foundation of America).

In general, asthma is considered a mild illness which should be managed by ambulatory care and rarely leads to hospitalization. Nevertheless, research suggests between 33 and 43% of the economic impact of this disease is related to emergency department use, hospitalization, and death[35,36].

According to the National Center for Health Statistics (2006), there were an estimated 754,000 (103 per 10,000 children) paediatric asthma visits to emergency departments and 198,000 (27 per 10,000 children) hospitalizations in 2004.

In 1996 more money was spent on rescue therapy than on prophylactic therapy[37]. Likewise, the cost of one admission to the hospital pays for three years of treatment with ICS[38]. Initiation of ICS therapy for children with asthma has been shown to result in monthly health care cost savings of almost 24% [39]. A retrospective, matched-cohort study reported a decrease of $28 for average monthly medical care in an ICS group because of reduced clinic visits, emergency department visits, and hospitalizations. However, costs increased to $89 in the non-ICS group[40]. Thus, the initial increase in cost associated with implementing an ICS regimen is offset by the decreased costs of medical care overall.

Asthma-related childhood deaths are rare and have been declining since 1999.Nevertheless, 186 paediatric asthma deaths occurred in 2004[31].

Characteristics of children most at risk for an asthma-related death include: (a) disease that is severe and improperly managed; (b) a near-fatal asthma attack; and (c) history of hospitalization or intubation for asthma[31]. Failure to appropriately treat episodes of asthma exacerbation is a chief contributing cause of poor outcome[31]. This suggests that uncontrolled disease may be the result of patients' or guardians' being non-adherent to the treatment regimen. The expense associated with uncontrolled disease makes it worthwhile to examine medication-taking habits prior to conducting costly tests or adding more medication[41].

Treatment Adherence: Definition and Considerations

Treatment adherence has been defined as "the extent to which a person's behaviour coincides with medical advice"[42]. The term "adherence" is preferred to the historical term, "compliance", because it possesses fewer negative connotations[43]. "Adherence" describes medication-taking behaviour from the patients' perspective[44]. The term suggests a more active role of patients in their own care[45]. This active role is in direct contradiction to "compliance", which suggests patients are either unable to follow provider instructions or patients are deliberately sabotaging their care[43]. Importantly, "adherence" eliminates the notion of blame[43].Rand & Wise (1994) highlight the fact that adherence does not necessarily have the same meaning in every instance; it is defined by the situation. It is important to explicitly set forth the framework of good adherence for the specific health behaviour under

study. In addition, it is necessary to specify the time frame for assessing each regimen component in order to avoid misrepresentation[44].

Farmer (1999) asserts that at least three distinct types of non adherence should be clearly identified: (a) patient takes no medication; (b) the patient stops therapy prematurely; and (c) the patient continues to take the medication, but not as prescribed. Dunbar-Jacob & Schlenk (2001) further delineates possible adherence patterns by emphasizing that patients may continue treatment, but with dosage interval errors. Patients may take less medication than prescribed because of adverse side effects[46-50]. Patients may also believe that a lower dose of medication is preferable[43,47].

Overdosing may occur because patients miss a dose of medication and "double up" in order to meet the requisite number of doses[51], or patients may feel that their symptoms require extra doses[51]. Studies have shown that patients do not consistently exhibit only one type of non-adherence pattern; therefore, variability in adherence may be the most common form of adherence problem[51].

Adherence in Pediatric Asthma

Studies of children with chronic illness consistently report adherence at or below 50% [47,48,52]. Rand & Wise (1994) suggest that non-adherence in the treatment of asthma commonly ranges from 30-70%. Negative consequences of non-adherence in the treatment of asthma include

increased wheezing, variability in pulmonary function that limits a child's daily activities[53], and possibly death[54].

There are several characteristics of asthma therapy that make non-adherence likely[55]. First, asthma is a chronic disease; the paediatric adherence literature has shown that longer disease duration is related to poorer adherence[48,56]. Second, patients with asthma are likely to experience symptom-free days. Extended periods of remission lead patients to reduce their treatment regimen[48,57-59]. Third, asthma treatment and management is complex and often involves taking multiple medications at different times throughout the day. Research has shown that the more complex the regimen, the more likely non-adherence[48,59-61]. Asthma medications, specifically ICS, do not always immediately or obviously affect symptoms[43]. Likewise, misunderstanding of the preventive role of ICS is associated with reduced adherence to its daily use[62]. Fourth, medications are expensive, require close monitoring, and can include undesirable side effects[63].

The method of medication delivery has been shown to affect adherence. Therefore, it is important to consider mode of delivery when comparing rates of adherence. To narrow this comparison, several studies have specifically targeted children's adherence to their ICS regimen. Coutts, Gibson, & Paton (1992) conducted a study with 14 children 9-16 years old. They defined a "compliant day" as one in which the prescribed number of puffs, or inhalations, were taken at appropriate times. Adherence to a prophylactic ICS regimen was recorded over one to three months by an electronic monitor, the Nebulizer Chronolog (NC; Medtrac Technologies, Inc, Lakewood, Colo.). The EM recorded underuse of medication on 55% of the study days, and overuse on 2% of study days. Seven participants did not take any prophylactic medication on at least one of the study days.

Milgrom and colleagues (1996) studied, for a period of 13 weeks, the adherence of 24 children ages 8-12 years to an ICS regimen. The median actual use was 58.4% as measured by the NC. Bender et al. (2000) studied 27 children ages 7-12 years. Average rate of adherence was 52% after 6 months as recorded by the electronic Doser – Clinical Trials version (Doser-CT; Medtrac Inc, Hudson, Mass.).

Jónasson, Carlsen, & Mowinckel (2000) reported ICS adherence for 122 children ages 7-16 years in a clinical trial of inhaled budesonide or placebo. Adherence was estimated by counting the number of doses remaining in the inhaler. Adherence dropped from 77% at 3 months to 49% at 27 months. Bender, Pedan, & Varasteh (2006) conducted a pharmacy database medication refill study involving 273 children less than 12 years old. Over a period of 12 months, only 19% of the study days were covered by refills.

McQuaid, Kopel, Klein, & Fritz (2003) used the MDI Log electronic asthma medication monitor (MDI Log; Westmed Technologies Inc, Englewood, Colo.) to measure adherence to ICS by 106 children ages 8-16 years over a period of one month.Mean adherence was 51%. The MDI Log was also used by McQuaid, Walders, Kopel, Fritz, & Klinnert (2005) to measure adherence by 53 children ages 7-16 years. Mean adherence was 48% over a period of four to five weeks.

Measuring Adherence

The measurement of adherence to medical treatments for children with chronic conditions is challenging[64]. In the absence of a "gold standard" of measurement, researchers have

advocated the use of a multiple measures approach in order to gather accurate and complete information. Several methods of assessment are available, but each has its strengths and limitations[65,66]. Available measures of adherence for asthma include physician report, self-report, biochemical measurement, pharmacy refill data, diary methods, and electronic monitoring[64,67].Four assessment methods that have demonstrated good reliability and validity[68] methods include (1) self-report by children and parents, (2) prescription refill data, (3) daily diary methods that emphasize short recall periods and the identification of barriers to adherence, and (4) objective, electronic monitors where possible.

Self-Report

Patient self-report is often used to measure adherence in patients with and asthma. Within a clinic setting, self-report is the most practical and inexpensive method of assessing adherence[69]. Burkhart and Dunbar-Jacob (2002) found that 71% of studies examining paediatric adherence from 1987-1996 utilized self-report measures of adherence. Of those studies, 36% of researchers used self-report as the only measure. Although self-report measures are vulnerable to reporting biases and problems with recall, they can provide information on a wide range of adherence behaviours[70]. Furthermore, they allow patients to identify and describe specific barriers to adherence. However, one significant limitation of this approach is that self-reported adherence is often exaggerated[36,71,72]. For example, self-reported adherence for inhaled corticosteroids for children with asthma was 95% compared to electronic monitoring data, which suggested only 54%[36]. Similarly, in a recent study examining rates of adherence to peak flow monitoring (home monitoring of lung function),

Burkhart and colleagues (2001) found higher rates of adherence for self-report (100%) compared to electronic monitoring (71%). These studies highlight the social desirability biases that may be associated with self-report, as well as the weakness of relying solely on this type of measurement.

Prescription Refill History

Prescription refill histories are another useful method of assessing adherence to medications. Pharmacy databases provide information on the specific type of medication, the amount of medication that is dispensed, and the date of refills. However, pharmacy data are limited in their ability to determine whether the medications were consumed or taken appropriately[71]. These data provide global estimates of medication adherence, which are useful for identifying patients who egregiously fail to refill prescriptions[72-74].

To date, only a few studies have been conducted using prescription refill data to assess adherence. One study indicated that approximately one-third of prescribed preventative medications remain unfilled across one year[75]. Sherman and colleagues (2001) found adherence rates of 59% for montelukast and 44% for fluticasone in children with asthma based on prescription refill data. Furthermore, they identified that children on fluticasone were twice as likely to have poor adherence (<50%) compared to children who were prescribed montelukast. This may be attributed to the medication delivery method and dosing schedule, in which montelukast is a pill given once a day and fluticasone is a metered-dose inhaler typically given twice a day. Similarly, prescription refill data suggested poor adherence for cromolyn (38%) compared to inhaled corticosteroids (61%) and theophylline (72%)[74].These differential rates of adherence may be attributed to dosing frequencies and

modes of administration. These estimates of adherence using pharmacy data are similar to those currently reported in the literature for other adherence assessment methods (e.g., electronic monitoring).

Daily Phone Diary

Daily phone diary methods have also been used in several studies of adherence[66,76]. The Daily Phone Diary (DPD) has been utilized with asthma populations and has demonstrated good reliability and validity[77]. The DPD uses a cued recall procedure to track parents through their activities over the past 24-hours[77,78], eliciting information about all activities lasting more than 5 minutes, including the type of activity, its duration, companions, and a rating of mood. Although diaries are a form of self-report, the unobtrusive nature of the 24-hour recall process reduces social desirability responding, as well as memory and recall problems, thus increasing the accuracy of the respondent's report and its temporal precision[66]. The disadvantages of the DPD method include its time-intensive nature, the complexity of the data that are obtained, and its limited usefulness for younger children[70]. In general, however, diary methods are beneficial because they allow researchers to gather important information about the processes related to poor disease management. For example, diary information may reveal that a child missed his/her treatment because of a sports activity that occurred during the usual treatment time. Thus, the reasons underlying poor adherence may best be identified through diary or self-report methods.

Electronic Monitoring

With the advent of new microchip technologies, electronic monitoring devices have now been developed to assess adherence behaviours, including the activation of MDIs, the opening of pill bottles, and the use of nebulizer machines[79,80]. Several electronic monitoring devices are available to measure adherence behaviours in children with asthma, including MDI monitors, wrist actigraphs, and vest monitors. These monitoring devices allow for precise recording of the date, time and duration of treatments. They also allow for continuous, long-term measurement that is unaffected by response bias[70]. Bender and colleagues (2000) found that electronic monitoring revealed more realistic estimates of adherence, a 50% rate for electronic data, 80% for self report and 69% for canister weight. Electronic monitors can identify a variety of adherence problems, including under-use of medication, overdosing, improper technique in taking a medication, delayed dosing, and drug "holidays" [64,69,70]. Unfortunately, as with all mechanical devices, electronic monitors can malfunction and data can be lost. Furthermore, these devices are expensive and may not be feasible for general clinic use[69]. Although electronic monitors have some limitations, as they are "debugged" they may become the future "gold standard"[81]. In the current proposal, convergence among self-report, prescription refill data, daily diaries, and electronic monitoring will be calculated and compared.

Barriers of Adherence to Medical Regimens

Patients with chronic conditions encounter numerous challenges in adhering to their treatment regimens. These challenges include forgetting, discontinuing medications because symptoms resolved, doubts about their usefulness, slow onset of effectiveness, lack of understanding of instructions or administration techniques, side effects, lack of resources (e.g., transportation, insurance, finances), and busy schedules[82-87]. Little is known about the specific barriers families encounter or whether these barriers vary by type of treatment and/or type of disease. Several factors may influence patterns of adherence for children with asthma, including knowledge, patient-provider communication and regimen characteristics. Recently, Logan, Zelikovsky, Labay, and Spergel (2003)[88] developed a measure examining adolescents' perceptions of barriers to adherence for asthma. Identifying the most common barriers is an important first step in the development of interventions that are effective in increasing adherence behaviours in children with chronic illnesses[69].

Knowledge and Patient-Provider Miscommunication

For children and their parents to effectively manage the treatment-related tasks associated with a chronic illness, they must understand the treatment regimen[65]. Patients with asthma who are less knowledgeable about their disease and its treatment requirements may be less adherent to their medical regimens[89,90].Research has also demonstrated that parents bringing their children to primary care settings often do not accurately *recall* what the medical provider has told them[91].

Studies have consistently suggested that children with asthma and their parents also have gaps in knowledge regarding their disease and the treatments[92,93]. For example, about 40-50% of parents of children with asthma were unsure of how to use inhaled steroids and sodium cromoglycate. Furthermore, 23% of parents were unaware that inhaled anti-inflammatory medications were preventative in nature[62], possibly leading to their use for the treatment of acute episodes[63]. Parents may also have fears about the long-term use of steroids, which lead to less than ideal adherence to the physician's prescription. Parent beliefs about medication use for children may be a significant barrier to adherence[94,95].

Donnelly and colleagues [92] reported that 80% of parents of both healthy children and children with asthma reported that "children shouldn't be given medications for long periods," while 40% reported that "any long-term medication is unnatural and harmful to children." These gaps in knowledge and misconceptions about medication usage may have a significant impact on rates of adherence for children with asthma. Mansour and colleagues (2000)[85] conducted focus groups with parents of African-American children with asthma. Results revealed that 20% of parents felt that they lacked knowledge about the disease, triggers of the disease, treatments, and the use of different medications. These results are similar to those found by Haby and colleagues (2002)[96]suggesting that 51% of parents do not feel that they possess a thorough understanding of asthma triggers. Furthermore, poor patient-provider communication and low socio-economic status were found to be the best predictors of poor adherence in children and adults with asthma[96].

Patient-provider miscommunication and lack of knowledge may contribute to adherence problems in children with asthma. However, there is conflicting evidence on the relationship between knowledge and adherence[62,97-100]. In a recent study of 106 children with asthma and

their parents, researchers found that there was no association between adherence and child knowledge about asthma and its treatments[100]. However, other studies have shown a positive relationship between knowledge and adherence, suggesting that greater knowledge is associated with higher rates of adherence[61,73]. These conflicting results may partially be attributed to the use of different measures of adherence, as well as the use of asthma knowledge measures that are yet to be validated. To date, however, few studies have assessed these types of communication problems and gaps in knowledge for asthma.

Regimen Characteristics

Management of asthma require adherence to medical regimens that are difficult and time-consuming. Research suggests that the complexity of the treatment, negative side effects, inconsistent efficacy of treatment, and delayed effects of stopping treatment can contribute to lower rates of adherence in children with asthma[63,101-103]. Factors such as the number of medications, the frequency of dosing, and routes of administration have all been shown to affect levels of adherence[83,104]. For example, adherence rates for inhaled medication prescribed twice a day are 71% compared to only 18% if those medications are prescribed four times a day[79]. In addition, 71% percent of mothers reported changing medication schedules for reasons of convenience, while 60% reported occasionally forgetting to dispense medications[105].

Medications that lack a short-term benefit or consistent symptom relief can also decrease rates of adherence. Researchers have found that adherence is better when treatment behaviours bring immediate, positive results or symptom reduction[106]. Children with asthma

may not understand the nature of preventative medications and treatments, such as airway clearance or steroidal inhalers, leading to lower rates of adherence for these treatments.

Deficits in Skills

Routes of administrations may also decrease the effectiveness of medications, leading to unintentional nonadherence. For example, only 7% of children with asthma have been found to demonstrate the necessary or most effective skills in using their MDIs[107]. The use of spacer devices has been found to increase the efficacy of bronchodilators and corticosteroids because they allow better delivery of medication into the bronchioles of the lungs and decreased morbidity[108,109]. However, few studies have examined adherence to spacer devices. Celano and colleagues (1998) found that 27% of participants had poor technique with a MDI/spacer, resulting in minimal delivery of medication into the lungs. Furthermore, several studies have shown that physicians and nurses do not demonstrate proper techniques for delivering asthma medications to their patients, which can contribute to the improper use of these devices[110].

Health-Related Quality of Life

Poor adherence can also adversely affect the health and well being of patients. Health-related quality of life (HRQOL) is an important construct to measure in children with chronic illnesses because it provides unique information about the impact of an illness and treatments

on an individual's life. If patients with asthma do not perceive that a medication is effective, they may be more likely to stop taking it. For example, Bernstein et al. (2002) found that lower HRQOL scores on the SF-36, a well-known generic HRQOL measure for adults, was associated with discontinuation of treatment for patients with hepatitis C. These data suggest that HRQOL may be linked in important ways to adherence to complex treatment regimens[111]. To date, little is known about the relationship between health-related quality of life and adherence for children with asthma.

Value of Inhaled Corticosteroid Therapy In Asthma Control

Corticosteroids have proved effective in the treatment of asthma, as they have in many other inflammatory diseases, because of their multiplicity of anti-inflammatory activities, including a broad effect on the transcription (both up-regulation and down-regulation) of many genes[112,113]. In its updated 2007 guidelines, the National Asthma Education and Prevention Program (NAEPP) reinforced the value of inhaled corticosteroid (ICS) therapy for mild, persistent asthma within all age groups, including children[114]. Inhaled corticosteroids (ICS) are considered the most effective anti-inflammatory drugs in the treatment of asthma in both children and adults. They reduce symptoms and number of hospitalizations, improve pulmonary function and bronchial hyper responsiveness (BHR)[114-116] and are more effective than β2-agonists alone[117]. Along with suppression of airway inflammation, nonspecific bronchial hyper responsiveness typically decreases by a factor of two to four[118]. Generally, the dose-response curve of ICS is relatively flat for a number of outcome measures[119] and for

many patients the therapeutic benefits of high-dosage versus low-dosage ICS may be marginal[110-112,119]. Nevertheless, in the majority of patients, even at low dosages, ICS rapidly improves clinical symptoms and measures of lung function[113]. The anti-inflammatory action of ICS in the long term reduces the frequency and severity of exacerbations[113-116].

The use of ICS on a regular basis also leads to reduced mortality from asthma. Suissa and colleagues used Canadian health data to review a population-based cohort of over 30,000 patients receiving anti-asthma drugs between 1975 and 1991. The authors calculated that the death rate from asthma decreased by 21% with each additional canister of ICS used by the patients in the preceding year[117].

In the START study, investigators looked into whether early intervention with ICS prevented progression of asthma in adults and children aged 5-11 years with newly diagnosed mild persistent asthma[118].A total of 7,241 patients were treated with low-dose budesonide (400 mcg/day for adults or 200 mcg/day for children younger than 11) or placebo for three years. During the first year, almost 34% of individuals in the placebo arm needed rescue treatment with ICS and 4% had had at least one severe asthma exacerbation. By comparison, in the budesonide treated group, only 20% needed additional ICS and 2% experienced severe exacerbations. Compared with placebo, budesonide therapy increased lung function over the course of one year of therapy and further after three years. This study suggests that early treatment with low-dose ICS decreases the risk of severe exacerbations, and improves asthma control and lung function in patients with mild persistent asthma of recent onset.

In the PAC study,[119] infants (aged 1 month to 3 years) of mothers with asthma were treated with ICS (budesonide 400 mcg/day) or placebo using a metered-dose inhaler and spacer device starting on day 3 of any wheezy episode and continued for two weeks. Children discontinued the trial if they developed persistent wheezing (more than five episodes lasting three days within a 6-month period, or daily symptoms for more than four weeks). Two hundred and ninety-four children, mean age 10.7 months, were randomized. Intermittent ICS therapy had no effect on the progression from intermittent to persistent wheeze, which was observed in 24% of the ICS treated group and 21% of the placebo treated group. In the IFWIN study[120],206 older children aged 6 months to 5 years with at least one atopic parent were given ICS (fluticasone 100 mcg twice daily) or placebo after one prolonged (>1 month) episode of wheezing or two physician-confirmed wheezy episodes. The dosage was adjusted every three months to the minimum required to control symptoms. At the age of 5 years there was no difference between the groups in the proportion of children with current wheeze, physician-diagnosed asthma or usage of asthma medication.In the PEAK study[121], 285 2-4 year olds considered at risk of asthma were randomly assigned to receive ICS (fluticasone propionate 88 mcg twice daily) or placebo using a metered dose inhaler and spacer for two years. They were then followed for a further observational year. During this year there were no significant differences between the groups in terms of symptom free days or exacerbations of wheeze. All of these studies seem to lead to the same conclusion, namely that ICS therapy does not prevent asthma.

Two large retrospective analyses evaluated the costs and resource utilization of patients with asthma[122,123] Colice et al. reviewed data from a large privately insured claims database from 31 companies in the U.S. from 1999 through 2005. 8 Of 1,283 patients with mild asthma who

met the entry criteria, 319 initiated regular ICS use, 414 initiated ICS plus LABA therapy, and 550 initiated LM treatment[122]. The analysis showed that physicians were not following recommended guidelines; instead, they were more likely to prescribe LMs or ICS agents plus a LABA for mild, persistent asthma[122]. The authors concluded that although outcomes were similar for all three groups—including asthma-related hospitalizations, ED visits, and SABA use—treatment with ICS monotherapy was less expensive, with lower asthma-related direct costs[122].Zeiger et al. also conducted a large retrospective analysis of the costs and resource utilization of patients with asthma using data from the extensive database of Kaiser Permanente Southern California health plan (N = 96,631), collected from 2002 to 2004.33 Adjusted total and asthma-related drug costs were lower with the use of ICS monotherapy than with most other monotherapies and almost all combination regimens[123].Furthermore, asthma-related resource utilization (i.e., hospitalization or ED visits related to asthma or the use of oral corticosteroids) was also lower for ICS monotherapy compared with LMs and most combination therapies[123]. The Thomas study showed that Patients who received optimized ICS treatment also had a 31% lower risk of hospitalization resulting from respiratory problems, compared with patients receiving an ICS/LABA combination[124].

Based on a review of clinical trials that followed children for up to six years, the NAEPP panel[114] found strong evidence that the use of inhaled corticosteroids in recommended dosages does not have long-term, clinically significant, or irreversible adverse effects. The most significant evidence cited by the NAEPP panel came from the Childhood Asthma Management Program (CAMP) study[125], which followed more than 1,000 children taking the inhaled corticosteroid budesonide, the mast-cell stabilizer nedocromil, or placebo for an average of six years.Although the CAMP study and other studies reviewed by the panel

showed that low to medium dosages of inhaled corticosteroids decreased growth velocity in children (causing a small difference in the rate of growth [approximately 1 cm per year] in the first year of use), this effect was not sustained, and there was no difference in target adult height by the end of the study. A similar study [136] which included fewer children but followed them for more than 10 years, found similar results. Not surprisingly, children with mild asthma who were taking inhaled corticosteroids had superior outcomes in both studies[125,136].Thus, the negligible risk of growth reduction is far outweighed by the positive effects of inhaled corticosteroid use in children. The NAEPP panel also reviewed 16 studies that examined bone mineral density,subcapsular cataracts, glaucoma, and hypothalamic-pituitary-adrenal axis suppression in adults and children treated with corticosteroids; these studies also showed negligible adverse effects from corticosteroid use. A recent study [137] of women 18 to 45 years of age who were taking high dosages of triamcinolone found a potential statistically significant decrease in bone mineral density in the hip (but not the spine) in the older women. However, the decrease was not clinically significant because the rate of loss was very low, and this study has been criticized[138].Thus, the NAEPP panel concluded that inhaled corticosteroids are safe and recommends them as first-line therapy for children and adults with persistent asthma.

MATERIALS AND METHODS

Source of Data

The study was a prospective study undertaken in the Respiratory medicine OPD, Dept Of Pediatrics of Sri Devraj URS Medical College and Research Institute,Kolar, during the period 1st December 2009 to 1st June 2011.

Method of Collection

Inclusion Criteria

- Children above 2 years and below 18 years of age who were previously diagnosed to have asthma and prescribed prophylactic inhaled steroids at time of discharge were included.

Exclusion Criteria

- All cases of Congenital heart disease, Cerebral palsy with recurrent respiratory infections, Lower respiratory tract infections and COPD.

Patients received budesonide 100 – 200 µg twice daily according to the NAEPP classification of asthma severity. Children below 6 years were also prescribed a spacer device to use along with MDI. Patients were followed up every 6 months for a minimum of 2 visits. At each follow up, review of asthma diary, completion of questionnaire and complete physical examination were done. Education regarding proper inhalational techniques, use of corticosteroids, asthma disease and triggering factors were given at time of discharge. In all cases the parents assumed the responsibility for supervising their children's recording of information on diary cards.

Patients were interviewed using a standard interview schedule and requested to maintain a diary regarding the dosing of aerosol therapy. The interview contained a structured questionnaire which included the following:

a) *Demographic Data*: Details regarding name,age and sex of the patient was obtained.

b) *Disease Data*: The severity of asthma was graded according to NAEPP classification at the time of diagnosis.

c) *Asthma Control*: The degree of asthma control was obtained by questioning about day symptoms, use of bronchodilators and limitation of activities. Night symptoms were not used due to erroneous results. Peak flow readings were not used due to financial limitations.

d) *Socio economic Status*: The economic status was classified as per modified B.G.Prasad classification. Income levels initially proposed by Prasad were converted into currently applicable levels by multiplying with a factor of 0.0493× Prevailing level of All India Consumer Price Index (AICPI).

e) *Caregiver education status*: Parents who had studied till 5^{th} standard either completed or not were considered to have received primary education. Parents educated beyond 5^{th} standard were considered to have received lower secondary and secondary education.

f) Reasons for non compliance

Compliance to medications was evaluated by studying the diaries maintained by the parents. Compliant day was defined as one in which the prescribed number of puffs as prescribed were taken each day.

OBSERVATIONS AND RESULTS

All children in age group 2 – 18 yrs who were previously diagnosed with asthma were studied from December 2009 to June 2011.A total of 95 patients were studied in the present study.

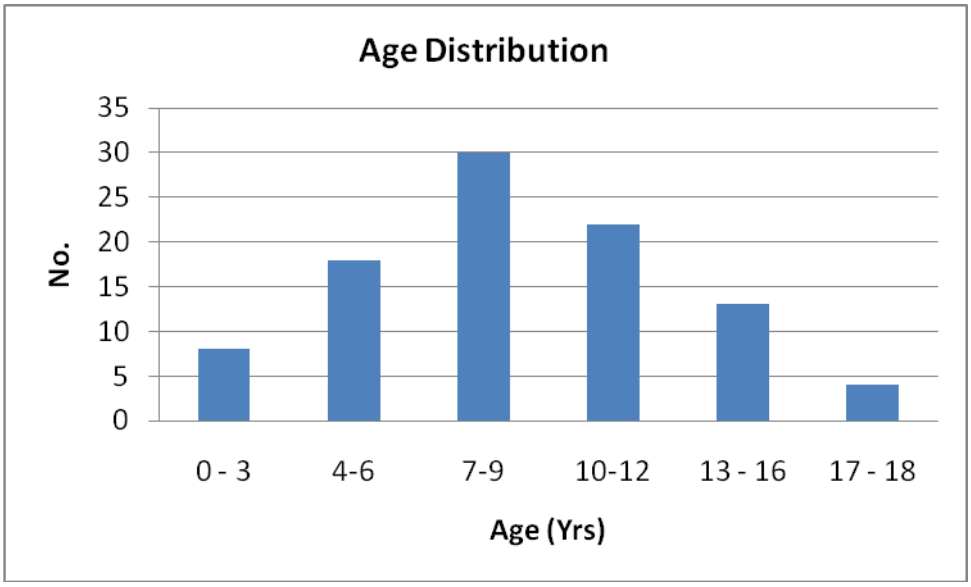
AGE DISTRIBUTION OF PATIENTS

Out of 95 children studied, the mean age was 7.4 yrs. Maximum no of cases was observed in age group 7 – 12 yrs.

Table 1

Age Distribution of patients

Age Group	No.(%)
0 - 3	8(8.4%)
4 - 6	18(18.9%)
7 - 9	30(31.5%)
10 - 12	22(23.15%)
13 - 16	13(13.7%)
17 - 18	4(4.2%)



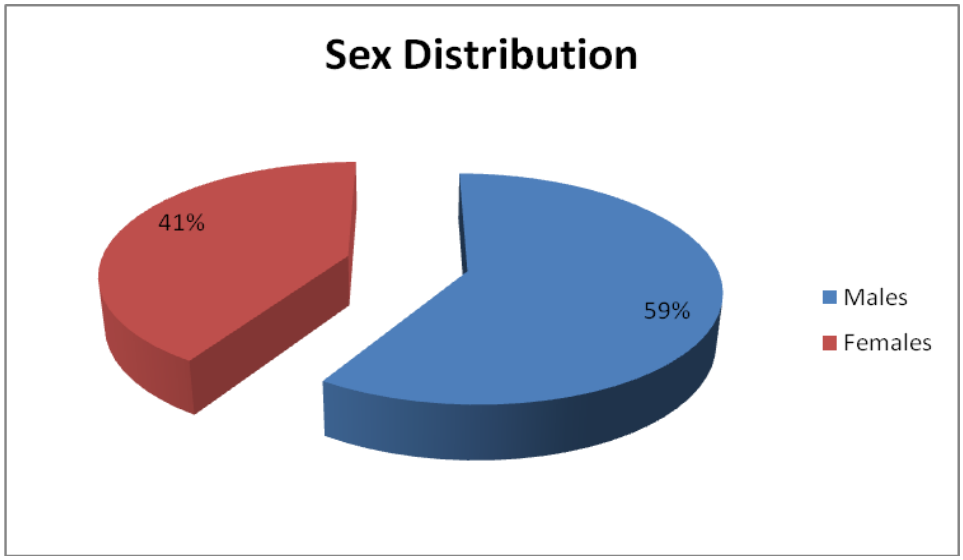
SEX DISTRIBUTION

Out of 95 children, 56 were males(59%) and 39 were females(41%) with a male: female ratio of 1.4:1.

Table 2

Sex Distribution of patients

Sex	No.	Percentage (%)
Males	56	59
Females	39	41
Total	**95**	**100**



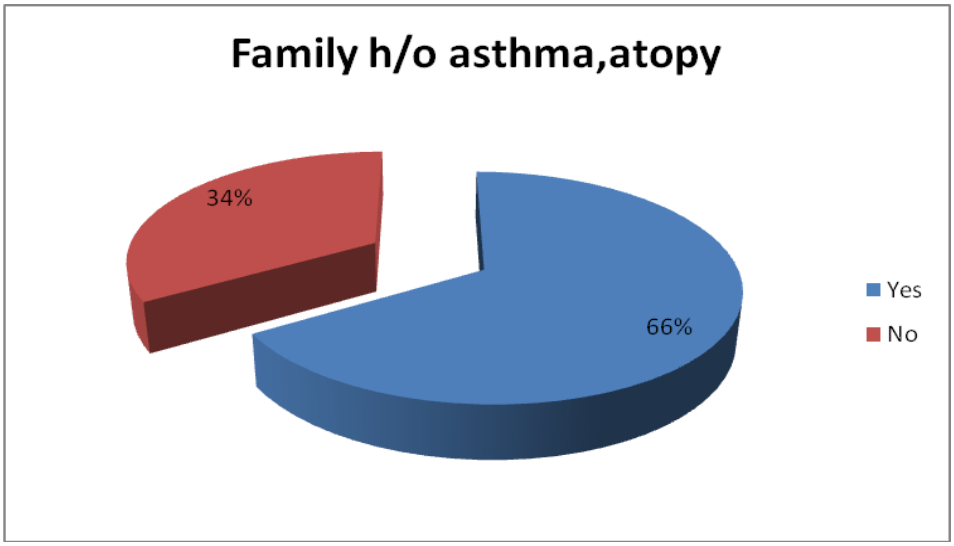
FAMILY HISTORY OF ASTHMA/ATOPY

Out of 95 patients, 63 children had parents with a positive history of asthma or atopy compared to 32 children whose parents had a negative history for the same. The no of children with a positive history was statistically significant.

Table 3

Family History of Atopy/Asthma

Family h/o	No.	Percentage (%)
Yes	63	66
No	32	34
Total	95	100



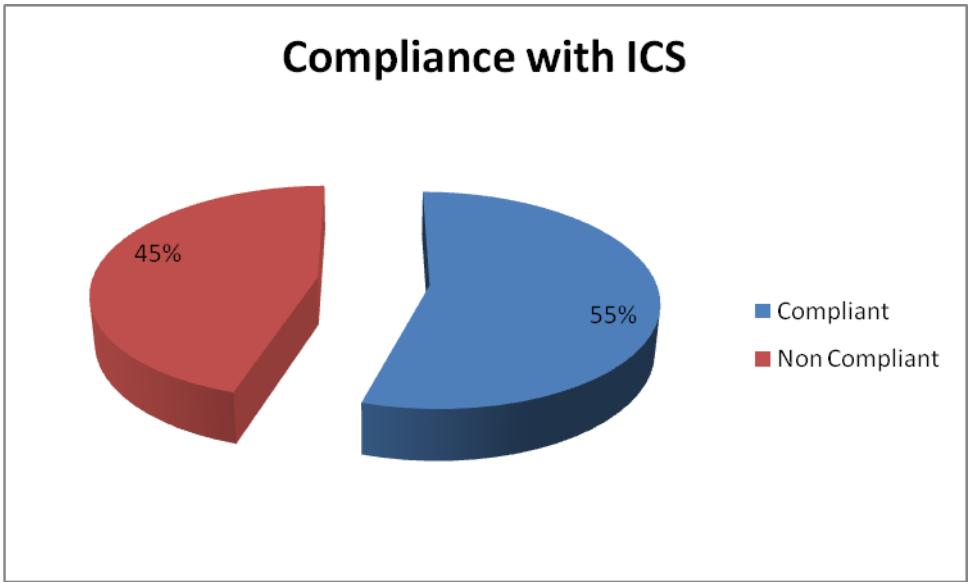
COMPLIANCE TO INHALED STEROIDS

A total of 52 children adhered to the prophylactic inhaled corticosteroids prescribed to them at the time of discharge.43 children out the total 95 children did not show compliance to their medications.

Table 4

Compliance with ICS therapy

Compliance	No.	Percentage (%)
Compliant	52	55
Non Compliant	43	45
Total	**95**	**100**



COMPLIANCE AND ASTHMA SEVERITY

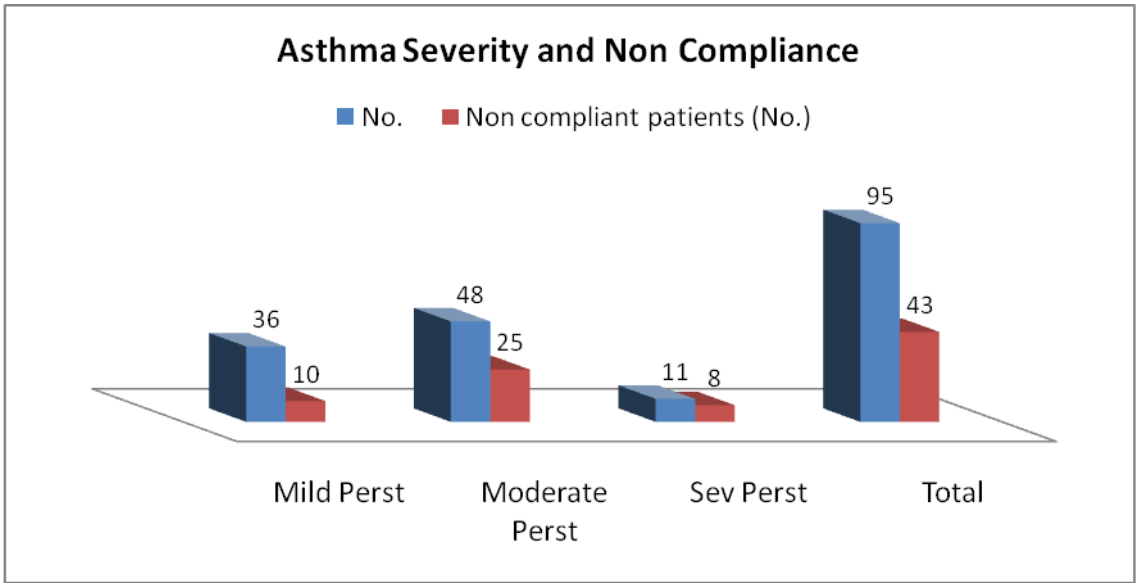
All children were graded for the severity of asthma according to the NAEPP guidelines 2002 at time of initial presentation. Accordingly,most of the children had moderate persistent asthma (50.5%). 38.9% of the children had mild persistent asthma and only 11.55 had severe persistent asthma.

A high rate of non compliance was seen (72.7%) among children having severe persistent asthma.52.1% having moderate persistent asthma showed non compliance to medications. Only 27.2% children having mild persistent asthma were non compliant with medications.

Table 5

Asthma Severity and Non Compliance

Severity	No	Non compliant patients (No.)	Percentage (%)
Mild Persistent	36	10	28
Moderate Persistent	48	25	52
Severe Persistent	11	8	72
Total	95	43	



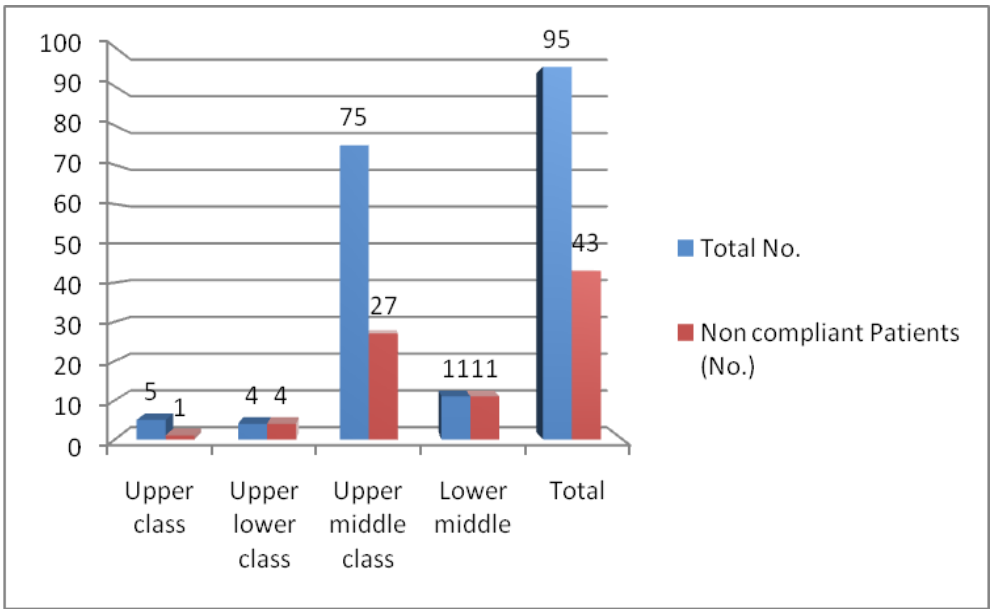
SOCIOECONOMIC STATUS AND NON COMPLIANCE

The socioeconomic status of all families were classified according to modified B G Prasad classification and recalculated with P Kumar's conversion factor.Majority of the families belonged to upper middle class (79%). 100% non adherence was observed in families belonging to lower middle class and upper lower class.Non compliance was observed in 27 children belonging to upper middle class (36%) and only 1 child in the upper class (20%).

Table 6

Socio-economic status

Socio-economic status	Total No.	Non compliant Patients (No.)	Percentage(%)
Upper class	5	1	20
Upper lower class	4	4	100
Upper middle class	75	27	36
Lower middle	11	11	100
Total	**95**	**43**	



CAREGIVER'S EDUCATION STATUS AND NON COMPLIANCE

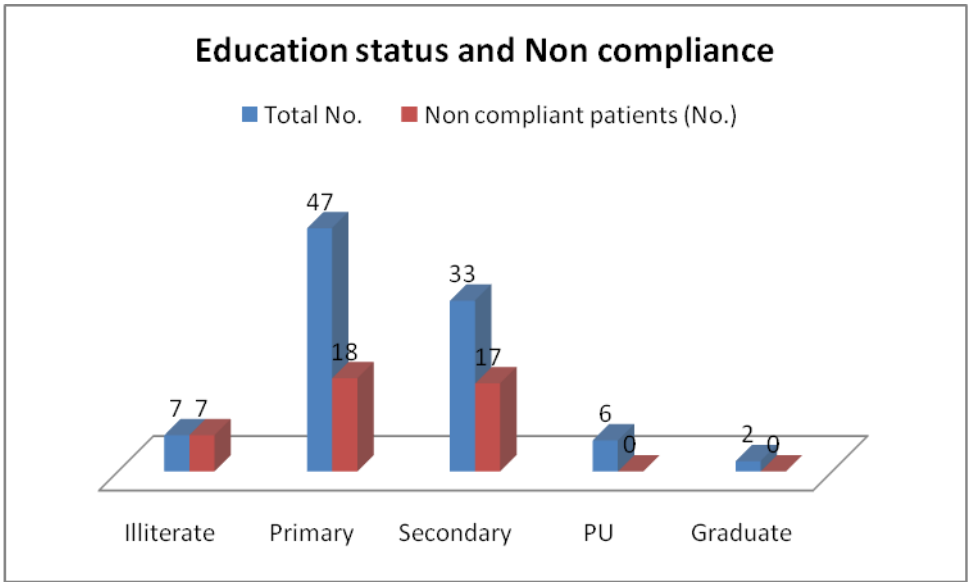
Out of 95 children, most of their caregivers had only received primary or secondary education (52%).6 caregivers had received education till 2nd P.U. and 2 graduates were present.

100% non compliance was noticed among illiterate caregivers and 56.25% children whose caregivers had received primary or secondary education showed non compliance to medications. In contrast, 100% adherence to medications was observed in those caregivers who had received education till P.U. or were graduates.

Table 7

Non compliance according to Caregiver's Education status

Caregiver's Education	Total No.	Non compliant patients (No.)	Percentage (%)
Illiterate	7	7	100
Primary	33	17	52
Secondary	47	18	38
PU	6	0	0
Graduate	2	0	0
Total	95	43	



REASONS FOR NON COMPLIANCE

The main reason for non compliance to ICS therapy in this study was lack of knowledge of disease process.28 out of 43 patients and their caregivers had misunderstood the disease process. The common misconception was asthma as a treatable disease and failure to recognize the preventive action of inhaled corticosteroids. The other common barrier was lack of understanding of inhaled steroids.

Cost was another major barrier to adherence and 21% quoted this as a reason for non compliance. Most of the patients belonged to the lower socioeconomic status.

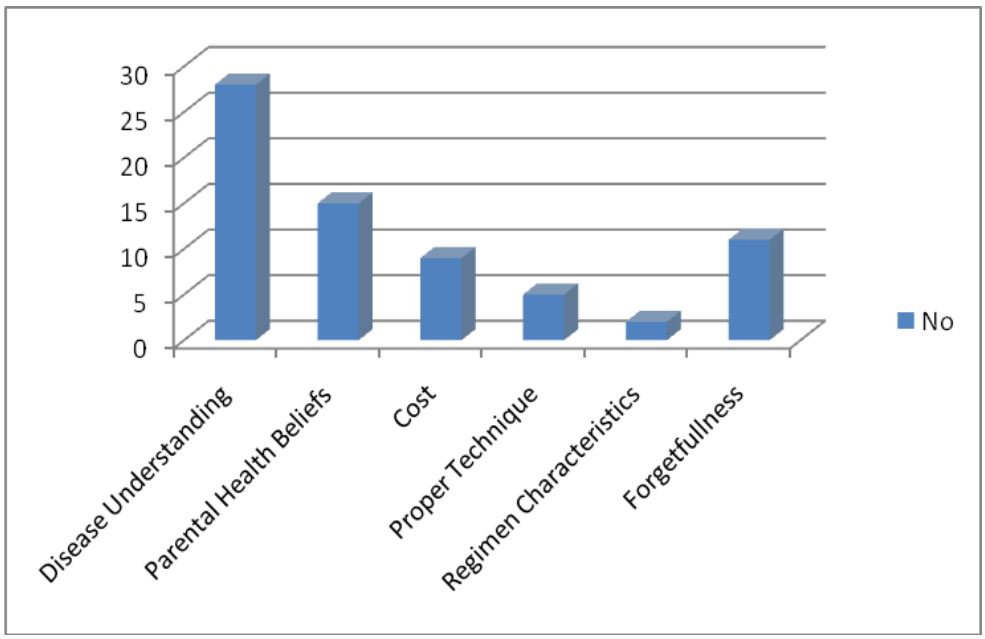
Parental health beliefs was also a barrier with 15 parents relating asthma to a curse rather than a preventable disease.10 parents did not give inhaled corticosteroids during periods of well being and 6 parents believed asthma to be an uncontrollable and unavoidable condition.

Improper inhalational techniques and forgetfulness were also barriers to proper adherence.

Table 8

Reasons for Non Compliance

Reason	No	Percentage (%)
Disease Understanding	28	65.1%
Parental Health Beliefs	15	34.8%
Cost	09	21%
Proper Technique	05	11.6%
Regimen Characteristics	02	4.5%
Forgetfulness	11	25.5%



Discussion

Few studies in India have attempted to measure the rate of non adherence to asthma medication in children. Non compliance to medication poses a major problem in terms of economic burden and school absenteeism. It also negatively affects the quality of life of the individual. In our study a low compliance of 55% was noted in children 2 – 18 yrs.

Rates of adherence to inhaled asthma medication therapy ranging from 30 to 70% have been reported in various studies involving children and adolescents[139].

Author	Year	Number of participants	Duration (months)	Method			
				Patient/legal guardian reports	Medication dispensing registered by pharmacists	Canister weighing	Electronic medication monitors
				Adherence rate (%)			
Milgrom et al.[34]	1996	24	4	95.4	-	-	13.7
Bender et al.[40]	1997	131	4	-	-	-	45.0
Celano et al.[32]	1998	55	5	75.0	-	44.0	-
Jonasson et al.[35]	2000	122	27	-	-	-	43.7
Carter et al.[37]	2003	141	6	-	41.0	-	-
Sherman et al.[20]	2000	116	8	-	61.0	-	-
Bender et al.[33]	2000	27	6	80.0	-	69.0	50.0
Butz et al.[36]	2005	221	6	75.0	-	-	27.0
Bollinger et al.[38]	2006	53	18	64.5	49.1	-	-
Lasmar et al.[42]	2007	106	12	93.2	61.0	-	-
Mudd et al.[28]	2008	221	12	-	57.2	-	-

Compliance rate in the present study was lower than other studies using the same method of assessment [139].Compliance rates could have been lower in the present study if an objective measurement of compliance was used.

The majority of children who came for follow up were between 7 -12 yrs of age. This is similar to other epidemiological surveys in which children 7-10 yrs of age were maximally affected [26,140].The male: female ratio in our study was 1.5:1, which was slightly higher than other survey [26].

Age variation was not found to be a significant risk factor to non adherence. Children between 4-8 yrs were found to be better compliant in our study. Younger children have better compliance due to greater parental involvement and motivation. Adolescents are least likely to adhere to medications. At on older age the adolescent may be rebellious and detest medication. They may feel stigmatized and conceal medication[141].Studies have proved regular counseling and exploration of psychosocial aspects to improve compliance among adolescents[141,142].

Sex was not a risk factor for non adherence in our study. Previous studies show no relationship between asthma control and sex[143,145].Earlier studies show poor asthma control in female children mainly due to increased bronchial hyper responsiveness and also due to neglect of the female child.

Asthma severity was graded at the time of diagnosis. Majority of patients suffered from moderate persistent asthma(52%).Poor compliance was seen among moderate persistent(52%) and severe persistent asthma(72%).This is similar to other studies which showed poor compliance as severity increases[144-146].Reasons for non compliance are patient dissatisfaction with medication, misunderstanding role of inhaled steroids and patient depression.

Majority of children belonged to upper middle class according to modified B G Prasad classification. Poor compliance was observed in upper lower class (100%) and lower middle class (100%).A compliance rate of 72% was observed in upper middle class children. This observation in our study was similar to other studies where poor compliance was observed in people from lower socioeconomic status[147,148].Reasons for poor compliance are cost of medications, parental health beliefs ,cultural beliefs and lack of education.

Caregiver's education status was a significant risk factor in our study and has been found to be significant in other studies[2].Causes for non compliance were lack of disease understanding, parental health beliefs, social stigma and lower expectations of asthma control.

The main reason for non compliance was lack of understanding of disease process. Most of the caregivers in this study believed asthma to be an untreatable disease and had not fully understood the preventive aspect of inhaled corticosteroids. Inhaled corticosteroid therapy was given only during exacerbation and not on daily basis. Some parents were not fully satisfied with medications and others had lowered expectation of asthma control and hence did not properly administer medication. These observations were similar to previous published literature.

Parental health beliefs were a significant barrier as reported in other studies[149].Social stigma was evident in the fact that parents were reluctant to administer inhaled corticosteroids in public. Some parents noticed exacerbations during monsoons and in damp conditions and attributed this to the disease. Most parents did not administer inhaled steroids during periods of well being. The practice of other regional medications was also observed mainly due to dissatisfaction with control of symptoms.

Cost was a barrier in this study since it was conducted in a rural area. All patients belonging to lower middle class showed non adherence to medications. Improper technique of inhalation was observed in 5 children. These children were mainly below 5 yrs of age and required a spacer along with metered dose inhaler for inhalation. Improper techniques included inadequate inhalation and unnecessary dosing. Few patients found the regimen to be complex due to the multiple dosing schedules.

The use of written action plans and asthma education program for the management of asthma control have now been studied and included in guidelines to improve compliance of inhaled corticosteroids. The key to better compliance is an effective asthma education program which educates the patient regarding disease process in asthma, asthma control, role of inhaled corticosteroids, side effects of medications and proper use of reliever drugs. Studies have proved better adherence rates among patients those have received an asthma education program compared to patients who have not. Patients report higher levels of adherence with medication prescribed by physicians who communicate well[150] and whose interactions were described as collaborative rather than authoritarian or generic. In a landmark study, asthma outcomes were improved when pediatricians were taught to provide simple messages combined with basic communication and counseling strategies[151]. Thus, it is important not merely to educate parents, but to discover and address their specific concerns and confirm that you share common goals and tailor the management plan to the client.

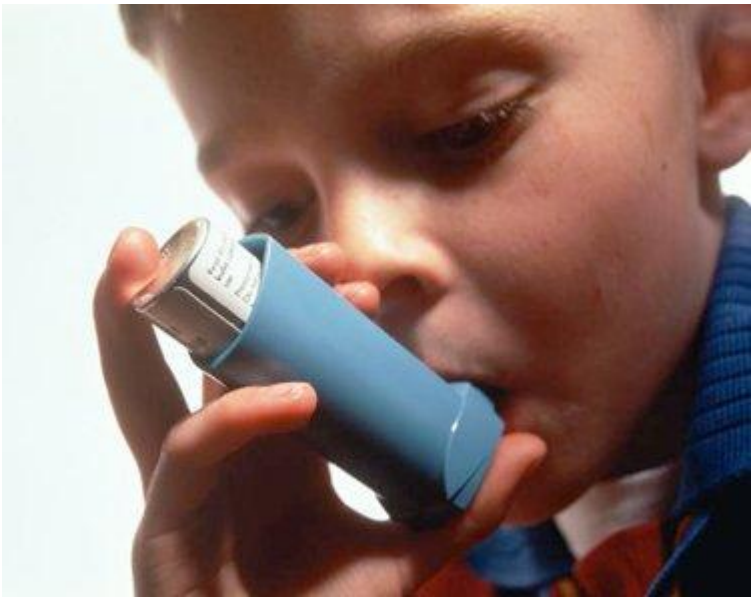
CONCLUSION

- There is a high prevalence of asthma in India and this is associated with significant morbidity and mortality.
- Inhaled corticosteroids are the mainstay of treatment in controlling asthma in children.
- Poor compliance to inhaled corticosteroids has been observed in our study and has been documented in several other studies.
- There are various barriers to poor adherence including low socioeconomic status and lack of understanding of disease process.
- Poor socioeconomic status and caregivers' education are significant risk factors to compliance of inhaled corticosteroids.
- Parent knowledge about asthma and understanding regarding preventive medications are significant barriers to compliance of medications.
- An effective asthma education program has been shown to improve compliance.
- Written asthma management plan and better doctor patient relationship are important steps to breaking down the barriers for non compliance of medications.

SUMMARY

Prevalence of bronchial asthma is over 5% in children in our country and the burden is constantly increasing. Poorly controlled asthma is associated with significant morbidity and socio-economic problems like absenteeism from school and a poor quality of life. Asthma, if unmanaged or undermanaged, can result in a number of avoidable complications including emergency room visits, hospitalizations, deaths, as well as permanent narrowing of the bronchial tubes and slowed growth in children from long term use of corticosteroids.In its updated 2007 guidelines, the National Asthma Education and Prevention Program (NAEPP) reinforced the value of inhaled corticosteroid (ICS) therapy for mild, persistent asthma within all age groups, including children. Rates of adherence to inhaled asthma medication therapy ranging from 30 to 70% have been reported in various studies involving children and adolescents (139). In our study a low compliance of 55% was noted in children 2 – 18 yrs. Poor socioeconomic status,caregivers' education and severity of asthma are significant risk factors to compliance of inhaled corticosteroids. Parent knowledge about asthma and understanding regarding preventive medications are significant barriers to compliance of medications. An effective asthma education program has been shown to improve compliance.Written asthma management plan and better doctor patient relationship are important steps to breaking down the barriers for non compliance of medications. The key to better compliance is an effective asthma education program which educates the patient regarding disease process in asthma, asthma control, role of inhaled corticosteroids, side effects of medications and proper use of reliever drugs. Studies have proved better adherence rates among patients those have received an asthma education program compared to patients who have not. it is important not merely to educate parents, but to discover and address their

specific concerns and confirm that you share common goals and tailor the management plan to the patient.



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Proforma

Name: **Hosp No:**
Age: **Sex:**
Address: **Informant:**

Aggravating Factors: Dust,Smoke,Pollen,Animal hair,Cold exposure,Food stuffs
(Tick appropriate) Exercise,Resp infections,Stress,Atopy,Anxiety,Dust mites.

Family H/O: Asthma/Atopy/Eczema/Allergic Rhinitis/Conjunctivitis

Symptoms:

Frequency of day symptoms:

Frequency of night symptoms:

Limitation of normal activity: Yes/No

School Absenteeism: Yes/No

Breathlessness/Wheeze: Yes/No

No of exacerbations:

Use of rescue bronchodilator:

Reasons for Non Compliance:

1) Proper Use Of MDI
   a) Do you shake the canister before use? Yes/No
   b) Do you properly apply the mask over Face / MDI in mouth before use? Yes/No
   c) Do you exhale before pressing inhaler? Yes/No

d)Do you inhale for >15s during each use? Yes/No

e)Do you take each puff separately? Yes/No

f) Do you check if canister is empty? Yes/No

2) Is the given drug regime costly for daily prophylactic use? Yes/No

3) Have you forgotten to take the medication? Yes/No

4) Have you understood the disease?

a) Are you aware of the risk factors? Yes/No

b) Are you aware it is preventable? Yes/No

c) Do you know prophylactic corticosteroids is the best treatment for prevention? Yes/No

d) Are you aware of the pathogenesis of the ailment? Yes/No

e) Are you aware it is a common ailment among children worldwide? Yes/No

5) Are you aware of the side effects associated with inhalational therapy? Yes/No

GENERAL EXAMINATION

Wt: HR:

Ht: RR:

BP: Pallor/Icterus/Clubbing/Cyanosis/Edema

Oral Cavity:

ENT Examination:

RESPIRATORY SYSTEM

Inspection:

Palpation:

Auscultation:

Percussion:

INVESTIGATIONS

Hb:	TC:
ESR:	DC:
AEC:	CRP:
Blood C/s:	

Chest X-Ray:

TREATMENT REGIME:

COMMENTS:

KEY TO MASTER CHART

F = female

M = male

SES = Socioeconomic status

UM = Upper middle class

LM = Lower middle class

UL = Upper lower class

U = Upper class

Perst = Persistent

N = no

Y = yes

Know = knowledge

PHB = Parental health beliefs

Prop Tech = proper technique

Name	Age	Sex	Family H/o	SES	Asthma Severity	Caregiver's Education
Bhavani	5 yrs	F	Y	UM	Moderate Perst	Secondary
Lakshmi	17 yrs	F	N	UM	Severe Perst	Illiterate
Anil	4 yrs	M	Y	UM	Mild Perst	Primary
Amulya	6 yrs	F	Y	UM	Mild Perst	Primary
Manasa	7 yrs	F	Y	UM	Moderate Perst	Primary
Amarnath.K	9 yrs	M	Y	UM	Moderate Perst	Primary
Jahnavi	8 yrs	F	N	UM	Moderate Perst	Secondary
Maheshwari	3 yrs	F	Y	UM	Mild Perst	Graduate
Rajesh	7yrs	M	N	UM	Moderate Perst	Secondary
Vishwanath	10 yrs	M	Y	LM	Moderate Perst	Secondary
Deepti	4 yrs	F	N	UM	Severe Perst	Primary
Mohan	8yrs	M	Y	UM	Moderate Perst	Primary
Ujwal	2 yrs	M	Y	UM	Severe Perst	Graduate
Swetha.M.R	9yrs	F	Y	UM	Mild Perst	Secondary
Rangaswamy	7 yrs	M	N	UM	Mild Perst	Secondary
Kiran	11 yrs	M	Y	UM	Mild Perst	Secondary
Praveen	9 yrs	M	Y	UM	Severe Perst	Primary
Ananda	5 yrs	F	Y	LM	Moderate Perst	Secondary
Prem	2 yrs	M	Y	UM	Moderate Perst	Primary
Aishwarya	7 yrs	F	Y	UM	Severe Perst	PU
Arun	9 yrs	M	N	UM	Severe Perst	Primary
Rudresh	7 yrs	M	Y	UM	Mild Perst	Primary
Naveen	13 yrs	M	N	UL	Moderate Perst	Illiterate
Vinoda	8 yrs	F	Y	UM	Moderate Perst	Primary
Tilakkumar	13 yrs	M	Y	LM	Severe Perst	Secondary
Shreyas	8 yrs	F	N	LM	Mild Perst	Primary
Pramodkumar	11 yrs	M	Y	UM	Mild Perst	Secondary
Anu	10 yrs	F	N	UL	Severe Perst	Primary
Akash.G	9 yrs	M	Y	UM	Mild Perst	Illiterate
Avinash.G.B	6 yrs	M	Y	UM	Mild Perst	Primary
Harshnath.S.S	3 yrs	M	N	UM	Mild Perst	Primary
Sheela	11 yrs	F	Y	UM	Mild Perst	Primary
Srikanth	7 yrs	M	N	LM	Severe Perst	Secondary
Supriya	4 yrs	F	N	UM	Moderate Perst	Illiterate
Jagadeesh	10 yrs	M	Y	LM	Mild Perst	Primary
Vinod kumar.K.C	7 yrs	M	N	UM	Moderate Perst	Secondary
Reshma	17 yrs	F	Y	LM	Moderate Perst	Primary
Nandeesh	4 yrs	M	N	U	Mild Perst	Primary
Sanjana	12 yrs	F	Y	UM	Mild Perst	PU
Krishna.A	8 yrs	M	Y	UM	Severe Perst	Secondary
Srinivas	12 yrs	M	Y	UM	Mild Perst	Primary
Abhijeeth	5 yrs	M	Y	UM	Mild Perst	Secondary
Jessy	7 yrs	F	N	UM	Mild Perst	PU
Chandan	5 yrs	M	Y	LM	Moderate Perst	Secondary

Sumanth Raj	3 yrs	M	N	UM	Mild Perst	Primary
Leela	8 yrs	F	Y	U	Severe Perst	Secondary
Darshan	6 yrs	M	N	UM	Mild Perst	Primary
Sachin	14 yrs	M	Y	UM	Mild Perst	PU
Bagyavan	7 yrs	M	Y	U	Mild Perst	Secondary
Sreya	2 yrs	F	Y	U	Moderate Perst	Secondary
Pramod	5 yrs	M	N	UM	Mild Perst	Primary
Uday	11 yrs	M	Y	UM	Mild Perst	Secondary
Sachin E	6 yrs	M	Y	UL	Moderate Perst	Primary
TejaG	10 yrs	M	Y	LM	Moderate Perst	Illiterate
Deepa	7 yrs	F	Y	UM	Mild Perst	Primary
Nisthitha	18 yrs	F	Y	UM	Moderate Perst	Secondary
Abdul	7 yrs	M	Y	UM	Mild Perst	Secondary
Keerthi	13 yrs	F	N	UM	Mild Perst	Illiterate
Shubha	3 yrs	F	Y	UM	Moderate Perst	Primary
Fawaz	4 yrs	M	N	UM	Moderate Perst	Primary
Divya	12 yrs	F	Y	UM	Mild Perst	Secondary
Leela	8 yrs	F	N	UM	Mild Perst	PU
Hassan	15 yrs	M	Y	UM	Mild Perst	Secondary
Kavya KA	5 yrs	F	Y	UM	Moderate Perst	Primary
Shanthi	2 yrs	F	N	UM	Mild Perst	Secondary
Salim	7 yrs	M	Y	UM	Mild Perst	Primary
Lofelin	13 yrs	M	N	UM	Moderate Perst	Primary
Priyank	11 yrs	M	Y	UM	Mild Perst	Primary
Shreya	14 yrs	F	Y	UM	Moderate Perst	Primary
Manjunath	10 yrs	M	Y	UM	Moderate Perst	Primary
Varshitha	10 yrs	F	N	UM	Mild Perst	Secondary
Ganga	12 yrs	M	Y	UM	Moderate Perst	Primary
Sunil	7 yrs	M	N	UM	Moderate Perst	Primary
Bhagyajyothi	14 yrs	F	Y	UM	Moderate Perst	Primary
Niveditha	11 yrs	F	Y	UM	Moderate Perst	Secondary
Suhas	15 yrs	M	N	UM	Moderate Perst	Primary
Tilak	12 yrs	M	Y	UM	Moderate Perst	Primary
Owais	6 yrs	M	Y	UM	Moderate Perst	Primary
Rajeshwari	8 yrs	F	Y	UM	Moderate Perst	Primary
Jalaja	11 yrs	M	N	UM	Moderate Perst	Secondary
Meghana	17 yrs	F	Y	UM	Mild Perst	Secondary
Deekshitha	13 yrs	F	N	UM	Moderate Perst	Secondary
Poornachandra	6 yrs	M	Y	UM	Moderate Perst	Primary
Ranjitha	8 yrs	F	N	UM	Moderate Perst	Primary
Punnet	12 yrs	M	Y	UL	Moderate Perst	Illiterate
Ramesh	14 yrs	M	Y	UM	Moderate Perst	Primary
Boomika	12 yrs	F	N	UM	Moderate Perst	PU
Kavan	7 yrs	M	Y	UM	Moderate Perst	Primary
Ravikumar	13 yrs	M	Y	UM	Moderate Perst	Primary
Vinayraj S.	6 yrs	M	N	U	Moderate Perst	Primary
Roshini. P.	7 yrs	F	Y	UM	Moderate Perst	Primary

Punith Muthuraj	11 yrs	M	N	UM	Moderate Perst	Secondary
Varsha	9 yrs	M	Y	LM	Moderate Perst	Secondary
Vikas S.Gowda	14 yrs	M	Y	LM	Moderate Perst	Secondary
Sahana	12 yrs	F	Y	LM	Moderate Perst	Secondary

Compliance with ICS	Reasons for non compliance
N	Know,PHB
N	Know,PHB
Y	
Y	
N	Know
Y	
Y	
Y	
Y	
N	Cost,forgetfullness
N	Know,Prop Tech
Y	
Y	
Y	
Y	
Y	
N	PHB
N	Cost
Y	
Y	
Y	
Y	
N	Cost
Y	
N	Know,PHB
N	Know,PHB
N	Forgetfullness
N	Cost
N	Know
Y	
Y	
Y	
N	Know
N	Knowledge,PHB
N	Know
N	Knowledge,PHB
N	Cost
Y	
Y	
N	
N	Regimen,forgetfullness
Y	
Y	
N	Cost

N	Know,PHB
N	Knowledge,Prop Tech
N	Know
Y	
Y	
Y	
N	Knowledge,Prop Tech
Y	
N	Cost
N	Know,PHB
Y	
Y	
Y	
N	
N	Know,PHB
N	Knowledge
Y	
Y	
Y	
N	Prop Tech
Y	
Y	
N	Knowledge
Y	
Y	
N	Know,PHB
N	PHB
N	Know
Y	
N	Cost
Y	
Y	
Y	
Y	
Y	
N	PHB
N	Forgetfullness
N	Knowledge,PHB
Y	
Y	
N	Cost
Y	
Y	
Y	
Y	
Y	
Y	

N	Regimen,forgetfullness
N	Cost
Y	
N	PHB,Knowledge