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Comparison of Effectiveness of Dexamethasone versus Prednisolone for Children with Acute Exacerbation of Asthma

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Abstract: ***Background:*** Acute asthma exacerbations are a major cause of pediatric emergency department visits and hospital admissions. Systemic corticosteroids are essential in management, with prednisolone traditionally used; however, dexamethasone offers a shorter dosing regimen that may improve compliance without compromising efficacy. ***Objective:*** To compare the effectiveness of two doses of oral dexamethasone with a five-day course of oral prednisolone in children presenting with moderate acute asthma exacerbations. ***Methods:*** This comparative analytic study was conducted at the Department of Pediatric Medicine from June to November 2022. A total of 256 children aged 5–14 years with moderate asthma exacerbations were enrolled and randomly allocated into two equal groups. Group A received oral prednisolone (1 mg/kg/day in divided doses for five days), while Group B received oral dexamethasone (0.3 mg/kg in two doses 24 hours apart). Clinical symptoms, peak expiratory flow rate (PEFR), oxygen saturation (SpO_2), supplemental oxygen requirement, and Pediatric Asthma Control Trial (PACT) outcomes were assessed at admission, discharge, and day-7 follow-up. Data were analyzed using SPSS version 25.0. ***Results:*** The mean age of participants was 9.01 ± 2.78 years in the prednisolone group and 9.19 ± 2.88 years in the dexamethasone group (p = 0.611). Both groups showed significant and comparable improvement in PEFR, with mean values exceeding 80% at day-7 follow-up (85.3% vs. 85.4%, p = 0.797). Oxygen saturation normalized in all patients by discharge, and no relapse was observed in either group during follow-up. PACT scores demonstrated complete symptom resolution at day seven in both groups, with no statistically significant differences between treatment regimens. ***Conclusion:*** Two-dose oral dexamethasone is equally effective as a five-day course of oral prednisolone for the treatment of moderate acute asthma exacerbations in children. Its shorter regimen and comparable clinical outcomes make dexamethasone a practical and effective alternative in pediatric asthma management.

Keywords: Acute asthma exacerbation; dexamethasone; prednisolone; children; corticosteroids.

INTRODUCTION

Asthma is one of the most common chronic respiratory diseases in childhood and remains a major global public health challenge. It is characterized by chronic airway inflammation, bronchial hyperresponsiveness, reversible airflow obstruction, and episodic respiratory symptoms such as wheezing, cough, chest tightness, and shortness of breath. The disease course is variable, ranging from mild intermittent symptoms to severe persistent disease with frequent exacerbations requiring emergency medical care (Global Initiative for Asthma [GINA], 2023). Despite advances in preventive strategies and controller therapies, acute exacerbations continue to contribute substantially to pediatric morbidity, healthcare utilization, and socioeconomic burden worldwide.

Globally, asthma affects an estimated 300 million individuals, with children accounting for a significant proportion of cases (Masoli et al., 2004). Epidemiological data indicate marked geographical variation in asthma prevalence, with higher rates reported in developed countries; however, developing countries are experiencing a rising trend, likely due to urbanization, environmental pollution, and changing lifestyles (Asher et al., 1998; Pearce et al., 2017). In Pakistan, childhood asthma prevalence has been reported to range between 4% and 20%, depending on the region and study population, making it a leading cause of pediatric emergency department visits and hospital admissions (Khan et al., 2019; Waqar et al., 2019).

Asthma exacerbations are acute or subacute episodes of progressive worsening of respiratory symptoms and lung function that often necessitate urgent medical intervention. These exacerbations are commonly triggered by viral respiratory infections, allergen exposure, air pollution, tobacco smoke, and poor adherence to controller medications (Jackson et al., 2011; Castillo et al., 2017). In children, exacerbations represent a critical component of disease burden and are associated with impaired quality of life, school absenteeism, and increased risk of future severe attacks (Fuhlbrigge et al., 2012). Importantly, even children with previously mild or well-controlled asthma remain vulnerable to acute exacerbations.

Systemic corticosteroids play a central role in the management of moderate to severe asthma exacerbations. Their anti-inflammatory effects reduce airway edema, inhibit inflammatory mediator release, enhance β_2-agonist responsiveness, and decrease the risk of relapse following emergency treatment (Rowe et al., 2001). Current international guidelines, including those from GINA and the National Asthma Education and Prevention Program (NAEPP), recommend early administration of systemic corticosteroids for children who fail to respond adequately to initial bronchodilator therapy (NAEPP, 2007; GINA, 2023).

Prednisolone (or prednisone) has traditionally been the corticosteroid of choice in pediatric asthma exacerbations. It is usually administered orally at a dose of 1–2 mg/kg/day for three to five days. While effective, prednisolone has several limitations, including a relatively short biological half-life (12–36 hours), bitter taste, gastrointestinal side effects, and the need for multiple daily doses over several days (Lucas-Bouwman et al., 2001). These factors may negatively affect treatment adherence, particularly in young children, leading to incomplete therapy and increased risk of relapse.

Dexamethasone, a long-acting corticosteroid with a biological half-life of 36–72 hours, has emerged as a potential alternative to prednisolone in the treatment of acute asthma exacerbations. Its prolonged duration of action allows for shorter treatment regimens, often consisting of one or two doses, which may improve compliance and reduce vomiting associated with repeated dosing (Keeney et al., 2014; Wei et al., 2019). Dexamethasone has been widely used in other pediatric conditions such as croup, where its efficacy and safety profile are well established.

Over the past two decades, multiple randomized controlled trials and meta-analyses have evaluated the comparative effectiveness of dexamethasone and prednisolone in pediatric asthma exacerbations. Most studies have demonstrated that dexamethasone is non-inferior to prednisolone with respect to symptom resolution, relapse rates, hospitalization, and lung function improvement (Cronin et al., 2015; Paniagua et al., 2017; Nitchingham et al., 2019). Additionally, dexamethasone has been associated with lower rates of vomiting and better adherence, making it an attractive option in emergency and outpatient settings.

However, despite growing international evidence, data from low- and middle-income countries, including Pakistan, remain limited. Differences in healthcare infrastructure, patient demographics, environmental exposures, and treatment adherence patterns necessitate local research to validate international findings. Furthermore, variations in dosing regimens, study designs, and outcome measures across previous studies highlight the need for context-specific comparative analyses.
Therefore, the present study was designed to compare the effectiveness of a two-dose oral dexamethasone regimen with a conventional five-day course of oral

prednisolone in children presenting with moderate acute asthma exacerbations. The study aimed to assess clinical outcomes including symptom resolution, peak expiratory flow rate improvement, oxygen saturation, relapse, and quality of life at day seven. By generating local evidence, this study seeks to inform clinical practice and support the adoption of simplified, effective treatment strategies for pediatric asthma exacerbations.

MATERIALS AND METHODS

This comparative analytic study was conducted at the Department of Pediatric Medicine, including the Emergency Department and Outpatient Department, Bahawal Victoria Hospital, Bahawalpur. The study was carried out over a period of six months, from 1st June 2022 to 30th November 2022, after obtaining approval from the institutional ethical review committee.

A total of 256 children aged between 5 and 14 years presenting with moderate acute asthma exacerbations were enrolled in the study. Moderate asthma exacerbation was defined clinically by the presence of wheezing, cough, and shortness of breath, along with a peak expiratory flow rate (PEFR) between 40% and 80% of the predicted value and oxygen saturation (SpO_2) greater than 90% on room air. Children who had received no corticosteroids or only a single dose of corticosteroid prior to enrollment were included. Exclusion criteria comprised children with severe asthma exacerbations requiring intensive care, corticosteroid use within the preceding two weeks, suspected pneumonia, or comorbid conditions such as congenital heart disease, chronic lung diseases other than asthma, and neurological or neuromuscular disorders.

After obtaining written informed consent from parents or guardians, demographic data including age and gender were recorded. Baseline clinical assessment was performed through detailed history and physical examination, with particular emphasis on respiratory symptoms, oxygen saturation, and peak expiratory flow rate. Peak expiratory flowmetry was conducted three times after appropriate instruction, and the highest value was recorded. The measured PEFR was converted into a percentage of the predicted value based on age, using the 50th percentile as the reference standard.

Participants were randomly allocated into two equal groups (128 patients each) using a lottery method. Group A received oral prednisolone at a dose of 1 mg/kg/day in two divided doses for five days, while Group B received oral dexamethasone at a dose of 0.3 mg/kg administered in two doses 24 hours apart. All patients received standard supportive therapy for asthma exacerbation according to institutional protocols, including short-acting β_2-agonists and supplemental oxygen when indicated.

Clinical assessments were performed at three time points: at admission (baseline), at discharge, and at follow-up on day seven. Outcome measures included resolution of asthma symptoms, PEFR, oxygen saturation, need for supplemental oxygen, and symptom control assessed using the Pediatric Asthma Control Trial (PACT). Relapse was defined as recurrence of asthma symptoms requiring additional medical intervention within seven days.

Collected data were entered and analyzed using the Statistical Package for Social Sciences (SPSS) version 25.0. Continuous variables such as age and PEFR were expressed as mean ± standard deviation, while categorical variables were presented as frequencies and percentages. Comparisons between the two groups were made using the independent sample t-test for continuous variables and the Chi-square test for categorical variables. A p-value of ≤ 0.05 was considered statistically significant.

RESULTS

A total of 256 children with moderate acute asthma exacerbation were included in the study, with 128 patients allocated to each treatment group. Group A received oral prednisolone, while Group B received oral dexamethasone. Baseline demographic characteristics were comparable between the two groups, with no statistically significant differences observed.

The mean age of children in the prednisolone group was 9.01 ± 2.78 years, compared with 9.19 ± 2.88 years in the dexamethasone group ($p = 0.611$). The majority of participants in both groups were aged between 5 and 10 years. Male predominance was observed in both groups, accounting for 57.1% in the prednisolone group and 53.9% in the dexamethasone group; however, this difference was not statistically significant ($p = 0.253$).

At the time of admission, all children in both groups presented with clinical features of moderate asthma exacerbation, including wheezing, breathlessness, and increased work of breathing. Peak expiratory flow rate (PEFR) at admission ranged between 40% and 70% in 100% of patients in both groups. Mean PEFR at admission was 54.4 ± 8.95% in the prednisolone group and 56.2 ± 8.25% in the dexamethasone group, with no statistically significant difference ($p = 0.095$).

Significant clinical improvement was observed in both groups at discharge. At this stage, all patients achieved PEFR values between 71% and 80% of predicted. Mean PEFR at discharge was 75.9 ± 3.02% in the prednisolone group and 75.8 ± 2.94% in the dexamethasone group (p = 0.789). At follow-up on day seven, all children in both groups demonstrated PEFR values greater than 80%, with mean values of 85.3 ± 3.15% and 85.4 ± 3.07% in the prednisolone and dexamethasone groups, respectively (p = 0.797).

Oxygen saturation measurements showed parallel improvement in both treatment groups. At admission, all patients had SpO_2 values between 90% and 95% and required supplemental oxygen. By the time of discharge, oxygen saturation improved to ≥95% in all patients, and none required supplemental oxygen. These findings were sustained at day-7 follow-up, with SpO_2 values ranging between 95% and 98% in both groups.

With regard to emergency department management, 66.4% of patients in the prednisolone group and 53.9% in the dexamethasone group received additional corticosteroid doses in the emergency department; however, this difference did not reach statistical significance (p = 0.056).

Assessment using the Pediatric Asthma Control Trial (PACT) revealed that at presentation, all patients in both groups had persistent asthma symptoms. Symptoms while sitting quietly were more frequent in the prednisolone group (78.9%) compared with the dexamethasone group (61.7%), a difference that was statistically significant (p = 0.003). Symptoms during light activity and sleep were comparable between the two groups. At follow-up on day seven, none of the patients in either group reported persistent symptoms under any PACT category, indicating complete symptom resolution. No relapse, defined as recurrence of symptoms requiring additional medical intervention within seven days, was observed in either treatment group.

Table 1. Baseline Demographic Characteristics of Study Participants

Variable	Prednisolone (n = 128)	Dexamethasone (n = 128)	p-value
Mean age (years)	9.01 ± 2.78	9.19 ± 2.88	0.611
Age 5–10 years	89 (69.5%)	83 (64.8%)	
Age 11–14 years	39 (30.5%)	45 (35.2%)	
Male	73 (57.1%)	69 (53.9%)	0.253
Female	55 (42.9%)	59 (46.1%)	

Table 2. Comparison of Pulmonary Function (PEFR) Between Groups

Time of Assessment	Prednisolone (Mean ± SD)	Dexamethasone (Mean ± SD)	p-value
At admission (%)	54.4 ± 8.95	56.2 ± 8.25	0.095
At discharge (%)	75.9 ± 3.02	75.8 ± 2.94	0.789
Day-7 follow-up (%)	85.3 ± 3.15	85.4 ± 3.07	0.797

Table 3. Pediatric Asthma Control Trial (PACT) Outcomes at Presentation

Symptom Category	Prednisolone n (%)	Dexamethasone n (%)	p-value
Persistent symptoms	128 (100.0)	128 (100.0)	–
Symptoms while sitting quietly	101 (78.9)	79 (61.7)	0.003
Symptoms with light activity	83 (64.8)	93 (72.7)	0.178
Symptoms during sleep	65 (50.8)	73 (57.1)	0.316

DISCUSSION

Asthma remains one of the most prevalent chronic respiratory diseases in children and continues to be a leading cause of emergency department visits and hospital admissions worldwide. Acute asthma exacerbations significantly contribute to disease burden, healthcare utilization, and impaired quality of life for affected children and their families. Systemic corticosteroids are a cornerstone of treatment for moderate to severe exacerbations, as they reduce airway inflammation, hasten recovery, and decrease relapse rates. Traditionally, prednisolone has been the corticosteroid of choice; however, dexamethasone has emerged as a potential alternative due to its longer half-life and simplified dosing regimen. The present study compared the effectiveness of a two-dose oral dexamethasone regimen with a conventional five-day

course of oral prednisolone in children with moderate acute asthma exacerbations.

The findings of this study demonstrate that dexamethasone is equally effective as prednisolone in improving clinical symptoms, pulmonary function, oxygen saturation, and asthma control at day seven. Both treatment groups showed marked and comparable improvement in peak expiratory flow rate (PEFR) from admission to discharge and follow-up, with mean PEFR values exceeding 80% at day seven. This indicates adequate resolution of airway obstruction in both groups and supports the non-inferiority of dexamethasone compared to prednisolone in restoring lung function.

These results are consistent with a growing body of international evidence. Multiple randomized controlled trials and meta-analyses have reported no significant differences between dexamethasone and prednisolone in terms of symptom resolution, relapse rates, hospital admissions, or pulmonary function outcomes (Keeney et al., 2014; Cronin et al., 2015; Paniagua et al., 2017; Nitchingham et al., 2019). A systematic review by Wei et al. (2019) concluded that dexamethasone, whether administered as a single dose or over two days, provides comparable efficacy to prednisolone for acute asthma exacerbations in children, with similar relapse rates at short-term follow-up.

In the present study, no relapse was observed in either group during the seven-day follow-up period. This finding aligns with studies by Shaheen et al. (2020) and Iqbal et al. (2021), which reported no statistically significant difference in relapse rates between dexamethasone and prednisolone-treated children. Although some studies have reported slightly higher relapse rates with single-dose dexamethasone, these differences were generally not clinically significant and did not translate into increased hospital admissions or adverse outcomes (Greenberg et al., 2008; Rehrer et al., 2016).

Oxygen saturation and supplemental oxygen requirements also improved uniformly in both treatment groups. All patients required supplemental oxygen at admission, reflecting the severity of airway obstruction and ventilation–perfusion mismatch during acute exacerbation. However, oxygen saturation normalized by discharge and remained stable at follow-up in both groups. These findings are in agreement with those reported by Elkharwili et al. (2020) and Banoth et al. (2022), who demonstrated comparable improvement in oxygenation parameters with dexamethasone and prednisolone.

An important aspect of asthma management is symptom control and functional recovery, which were assessed in this study using the Pediatric Asthma Control Trial (PACT). At presentation, all children in both groups exhibited persistent symptoms, highlighting the clinical severity at admission. Interestingly, symptoms while sitting quietly were more common in the prednisolone group than in the dexamethasone group at baseline, although this difference did not influence overall outcomes. By day seven, complete symptom resolution was observed across all PACT domains in both groups, indicating excellent short-term asthma control irrespective of the corticosteroid regimen used. Similar findings were reported by Paniagua et al. (2017), who found no significant difference in symptom persistence or quality-of-life scores between dexamethasone and prednisolone at day seven.

One of the key advantages of dexamethasone lies in its pharmacokinetic profile. With a longer biological half-life of 36–72 hours compared to 12–36 hours for prednisolone, dexamethasone allows for shorter treatment courses while maintaining sustained anti-inflammatory effects (Alangari, 2014). This simplified dosing regimen may improve adherence, particularly in pediatric patients, where poor palatability and vomiting associated with multi-day prednisolone therapy are common challenges (Lucas-Bouwman et al., 2001; Mitchell & Counselman, 2003). Although adherence and adverse effects were not directly measured in the present study, existing literature consistently reports lower rates of vomiting and better compliance with dexamethasone (Keeney et al., 2014; Wei et al., 2019).

From a public health and resource utilization perspective, the findings of this study have important implications. In low- and middle-income countries such as Pakistan, where healthcare resources are limited and follow-up may be inconsistent, a shorter and equally effective corticosteroid regimen could reduce treatment costs, improve compliance, and minimize the burden on healthcare facilities. Studies conducted in hospital settings have also shown shorter lengths of stay and comparable readmission rates with dexamethasone use (Parikh et al., 2015; Hemani et al., 2021).

Despite its strengths, this study has certain limitations. It was conducted at a single center, which may limit the generalizability of the findings. The follow-up period was limited to seven days, and longer-term outcomes such as late relapse or repeated exacerbations were not assessed. Additionally, adverse effects and treatment adherence were not formally evaluated. Future multicenter studies with longer follow-up durations and inclusion of patient-reported outcomes would provide more comprehensive evidence.

Nevertheless, this study adds valuable local data to the existing literature and supports the use of dexamethasone as an effective alternative to prednisolone for managing moderate acute asthma exacerbations in children. The results reinforce current evidence suggesting that shorter corticosteroid regimens can achieve comparable clinical outcomes while potentially improving adherence and convenience.

CONCLUSION

This study demonstrates that a two-dose oral dexamethasone regimen is equally effective as a conventional five-day course of oral prednisolone in the management of moderate acute asthma exacerbations in children. Both treatment options resulted in comparable improvement in clinical symptoms, pulmonary function, oxygen saturation, and asthma control at short-term follow-up. The simplified dosing schedule of dexamethasone offers a practical advantage by potentially improving treatment adherence and reducing caregiver burden. Given its comparable efficacy and convenience, dexamethasone represents a suitable alternative to prednisolone in pediatric acute asthma management. Further multicenter studies with longer follow-up are recommended to evaluate long-term outcomes and safety.

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